29

Draft Final

FOCUSED FEASIBILITY STUDY
SITE 01 -
McALLISTER POINT LANDFILL

NAVAL EDUCATION AND TRAINING CENTER
NEWPORT, RHODE ISLAND

Contract No. N62472-86-C-1282
July 1993

Prepared for:

Northern Division
Naval Facilities Engineering Command
Lester, Pennsylvania

TRC
TRC Environmental Corporation

1142

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EXECUTIVE SUMMARY

At the request of the U.S. Navy, TRC Environmental Corporation (TRC) has prepared this Focused Feasibility Study (FFS) for Site 01 - McAllister Point Landfill, at the Naval Education and Training Center (NETC), Newport, Rhode Island. The FFS is being conducted under the Navy's Installation Restoration Program and in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA).

Introduction

Four sites at the NETC facility are being investigated under a Remedial Investigation/Feasibility Study (RI/FS) program. A Phase I Remedial Investigation (RI) has been conducted to investigate the physical characteristics of the sites, as well as to identify potential sources of contamination, determine the nature and extent of contamination, and characterize potential health risks and environmental impacts. Detailed site background information, results of the investigations, and a characterization of the potential risks to human health and the environment posed by the sites are presented in a report entitled Remedial Investigation Technical Report (TRC, 1991). Additional investigations of these sites (Phase II) are currently being planned to fully characterize the sites and the potential risks to human health and the environment associated with the sites.

Based on a review of the potential human health risks posed by the various contaminated media at the NETC sites (as identified by the Phase I investigations), the stabilization of existing site conditions (source control) at Site 01 - McAllister Point Landfill was determined to be a high priority. Therefore, to expedite the decision making process and reduce the overall time frame required to clean up the site, it was determined that the preparation of a Focused Feasibility Study addressing source control at McAllister Point Landfill was appropriate. Implementation of a final source control remedial action will allow for the mitigation of potential risks to human health and the environment while additional site investigations are on-going. Management of contaminant migration, including consideration of the potential risks posed by leachate generation and ground water contamination, contaminated sediments, and hot spot areas (if any), will be addressed within a separate operable unit for the site, as appropriate. The management of migration component of the remediation effort can proceed as engineering studies and the Phase II RI are conducted and the results of additional site investigations become available.

Background

McAllister Point Landfill was the site of a sanitary landfill which operated over a 20-year period. From 1955 until the mid-1970s, the site accepted all wastes generated at the NETC naval complex. The landfill received waste from all operational areas, Navy housing areas (domestic refuse), and from the 55 ships homeported at Newport prior to 1973 (approximately fourteen 40-cubic yard containers each day). The materials reportedly disposed of at the site included spent acids, paints, solvents, waste oils (diesel, lubrication, and fuel), and PCB-contaminated transformer oil. In 1965, an incinerator was built at the landfill. From 1965 through 1970-71, approximately 98 percent of all the wastes were burned before being disposed of in the landfill. Following the closure of the landfill, a three-foot-thick covering of clay/silt was reportedly placed over the site. Current observations confirm the presence of a clay/silt material over portions of the landfill, although it is not continuous across the site. Since the closure of the landfill, the site has remained inactive.

Located in the central portion of the NETC facility, the site covers approximately 11.5 acres and is situated between Defense Highway and Narragansett Bay. Penn Central Railroad tracks run in a north-south direction, parallel to Defense Highway along the eastern side of the site. Access to the site is from Defense Highway, across the railroad tracks, and through a gate in the south-central portion of the site. Grass, weeds, and small trees cover most of the site. In the central portion of the site, several depressions are present where standing water collects during heavy precipitation events. Along the western edge of the site, the grade drops off quickly to the shoreline, changing by as much as 20 feet. Metal debris and concrete rubble are present along the shoreline of the landfill. A topographic map of the site is provided in Figure ES-1.

Site investigations have consisted of an Initial Assessment Study conducted in 1983, a Confirmation Study conducted from 1984 to 1985, a U.S. Army Corps of Engineers study conducted in 1988 and the Phase I RI, which was conducted from 1989 to 1990. Phase I RI sampling locations are indicated in Figure ES-2.

Focused Feasibility Study Process

The purpose of the Focused Feasibility Study is to identify and evaluate alternatives which are applicable to providing source control at the site. To meet this objective, available information regarding the nature and extent of contamination at the site and the relative risks posed by the presence of that contamination is reviewed. Potentially applicable or relevant and appropriate requirements (ARARs) and to-be-considered guidance (TBCs) are reviewed to identify those which may require consideration in the development of remedial alternatives. No chemical-specific ARARs or TBCs were identified for the source control action at McAllister Point Landfill. Ground water and leachate as well as contaminated sediments, potential hot spot areas, and landfill gas generation will be investigated further as part of the source control operable unit. Based on these additional investigations, associated cleanup standards and remedial alternatives will be addressed, as necessary, within a separate management of migration operable unit for this site.

Key to the development of remedial alternatives for a source control action at a landfill site is the consideration of U.S. EPA's expectations for remediation of such sites under the Superfund program. These expectations are listed in the National Contingency Plan [40 CFR 300.430(a)(1)] and in U.S. EPA's guidance on Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites (U.S. EPA, 1991a), where they are outlined as follows:

- The principal threats posed by a site should be treated wherever practicable, such as in the case of remediation of a hot spot.

- Engineering controls, such as containment, will be used for waste that poses a relatively low long-term threat or where treatment is impracticable.

- A combination of methods will be used as appropriate to achieve protection of human health and the environment. An example of combined methods for a landfill site would be treatment of hot spots in conjunction with containment (capping) of the landfill contents.

- Institutional controls, such as deed restrictions, will be used to supplement engineering controls, as appropriate, to prevent exposure to hazardous wastes.

- Innovative technologies will be considered when such technologies offer the potential for superior treatment performance or lower costs for performance similar to that of demonstrated technologies.

- Ground water will be returned to beneficial uses whenever practical, within a reasonable time, given the particular circumstances of the site.

These expectations were used to guide the development of remedial action objectives and potential remedial alternatives for the McAllister Point Landfill site.

Focused Feasibility Study Summary

Existing conditions at the McAllister Point Landfill site pose potential human health risks to trespassers based on current site use. Conditions also pose potential risks to the environment based on the possibility of erosion of surficial contamination and based on the continued generation of leachate as a result of infiltration of precipitation and the associated impacts on ground water quality. Based on these potential risks, Remedial Action Objectives were developed for the site. They are as follows:

- Minimize potential environmental impacts by minimizing off-site migration of surface soil contaminants, and by limiting the infiltration of precipitation to the underlying waste within the landfill area, thereby minimizing leachate generation; and

- Minimize potential risk to human health associated with exposure to the landfill area.

Remedial alternatives considered within the Focused Feasibility Study are limited to containment and control actions. If Phase II remedial investigations identify hot spot areas, sediments, or other site conditions which require treatment to address a principal threat, remediation of these areas will be considered separately on the basis of those results.

Four remedial alternatives were developed and evaluated in detail in response to the Remedial Action Objectives. They include the following:

- **Alternative 1 - No Action**
  The no action alternative must be considered under the requirements of the NCP.

Alternative 2 - Fencing, Surface Controls, and Deed Restrictions
This alternative involves the fencing of the site to restrict site access, limited improvements to poorly vegetated or poorly drained areas to reduce infiltration and surface erosion, and implementation of deed restrictions to limit future use and development of the site. Long-term storm water discharge monitoring is also included.

- **Alternative 3 - RCRA Subtitle D Soil Cap with Surface and Institutional Controls**
  This alternative involves the capping of the landfill area with a soil cap constructed in accordance with federal municipal solid waste landfill closure requirements. The cap provides a physical barrier to potential exposures to or erosion of surficial contaminants and provides some restriction of infiltration. This alternative also includes regrading of the site, and improvement of drainage features, a landfill gas management system, and a reduction in grade and provision of slope protection along Narragansett Bay. Fencing and deed restrictions would be included to limit site access and future site use and development. Long-term ground water and storm water discharge monitoring are also included, as well as additional site studies.

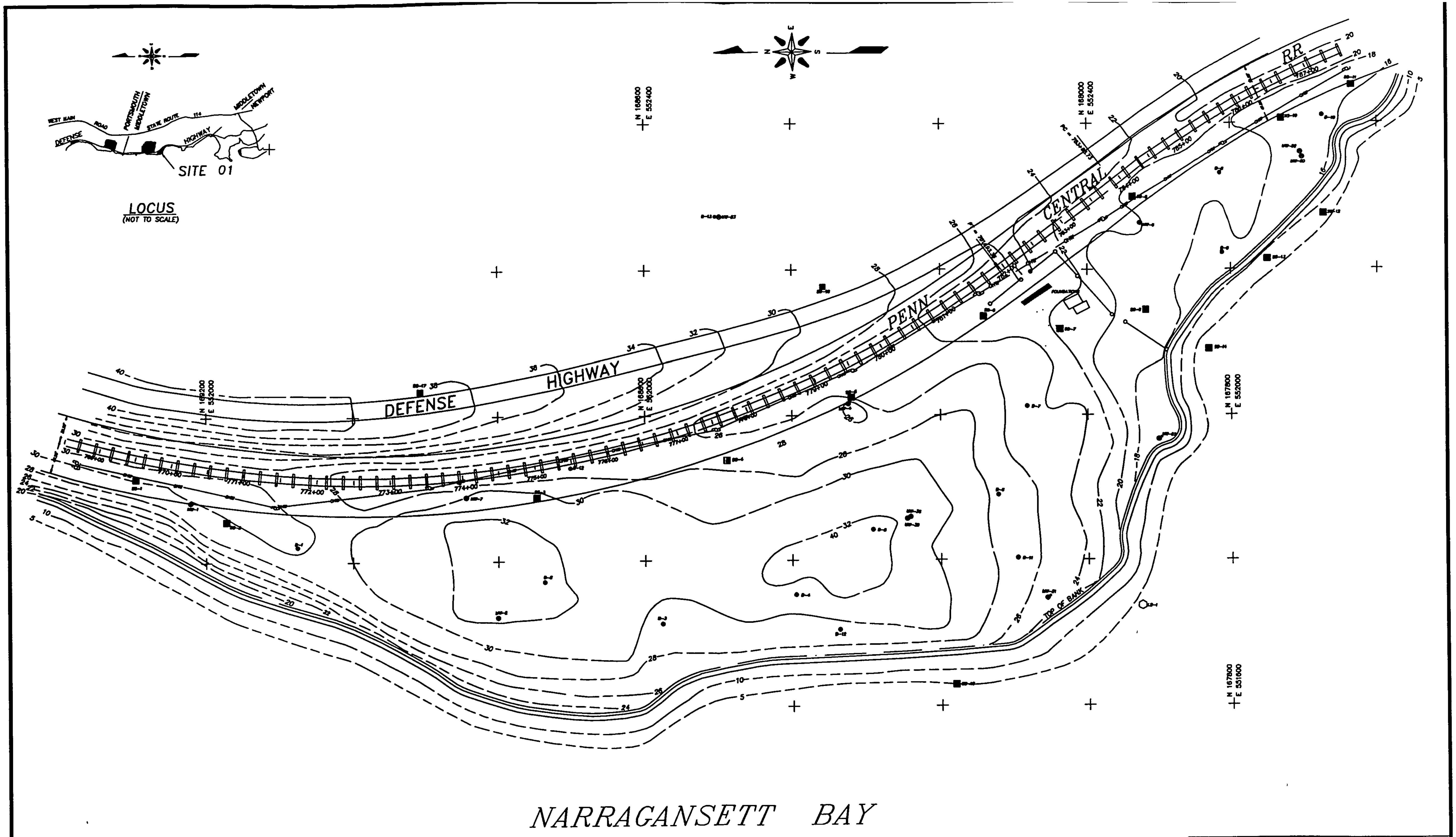
- **Alternative 4 - RCRA Subtitle C Multi-layer Cap with Surface and Institutional Controls**
  This alternative involves the capping of the landfill area with a multi-layer cap constructed in accordance with federal and state hazardous waste landfill closure requirements. The cap provides a physical barrier to potential exposures to or erosion of surficial contaminants as well as a significant barrier to infiltration of precipitation. As with Alternative 3, it includes regrading of the site, improvement of drainage features, a landfill gas management system, and a reduction in grade and provision of slope protection along Narragansett Bay. Fencing and deed restrictions would also be included to limit site access and future site use and development. Long-term ground water and storm water discharge monitoring would be conducted. This alternative also includes additional studies which would be required to determine if additional measures, beyond capping, must be taken to reduce the amount of ground water in contact with the contaminated materials of the landfill; whether hot spots within the landfill materials, if present, will need to be addressed by a separate remedial action or can be addressed by the landfill cap; whether landfill gas will require treatment; and the nature and extent of any near-shore sediments which have been affected by site-related contamination, and whether they will need to be addressed by a separate remedial action or whether they can be addressed through consolidation under the landfill cap.

An evaluation of these four alternatives against seven of the nine evaluation criteria specified in the NCP is presented in Tables ES-1 through ES-7. The remaining two criteria, community acceptance and State acceptance, will be evaluated on the basis of public and State comment on the remedy selection process.

Recommended Remedial Alternative

The recommended remedial alternative for the site is Alternative 4, a RCRA Subtitle C Multi-Layer Cap, supplemented by surface controls and institutional controls. This alternative will provide the greatest overall protection of human health and the environment of the final source control remedial alternatives evaluated. It will eliminate exposures of the landfill area to human and environmental receptors through the implementation of engineering controls. Potential risks associated with exposures to contaminated surficial materials will be addressed through the control of potential exposure pathways (through the placement of an impermeable barrier over the areas of contamination and fencing around the site) or through the control of future site usage (through deed restrictions). Implementation of the remedy is not expected to pose unacceptable short-term risks. The alternative meets USEPA expectations regarding Superfund remedial actions, including the use of engineering controls such as containment for waste that poses a relatively low long-term threat or where treatment is impracticable. This alternative will also comply with both location-specific and action specific ARARs.

Alternative 4 can be fairly easily modified to incorporate other remedial actions, as necessary. If, on the basis of additional site studies, removal and/or treatment of hot spot areas or consolidation of contaminated sediments within the area to be capped is required, these actions could be incorporated into the cap design such that they could be conducted prior to the construction of the cap. Similarly, leachate and landfill gas generation can be further evaluated during the landfill cap design phase and removal and/or treatment systems incorporated as necessary during the final design of the cap. A multi-layer cap could also complement a future ground water/leachate remediation action by significantly reducing infiltration as a source of leachate generation and thereby reducing the volume of leachate and contaminated ground water requiring treatment over time. This flexibility allows source control remedial decision and conceptual design activities to move forward for this operable unit, while other areas of the site or environmental media requiring additional investigation are further evaluated, in accordance with the Phase II RI/FS Work Plan (TRC, 1992) and associated remedial design studies.



LEGEND

- MONITORING WELL
- EXISTING MONITORING WELL
- LEACHATE SPRING
- SURFACE SOIL SAMPLE
- TEST BORING
- GRID TICK MARK
- CHAIN LINK FENCE
- UTILITY POLE
- OHW — OVERHEAD WIRES

60 0 60 120 180 240 FEET

20 0 20 40 60 METERS

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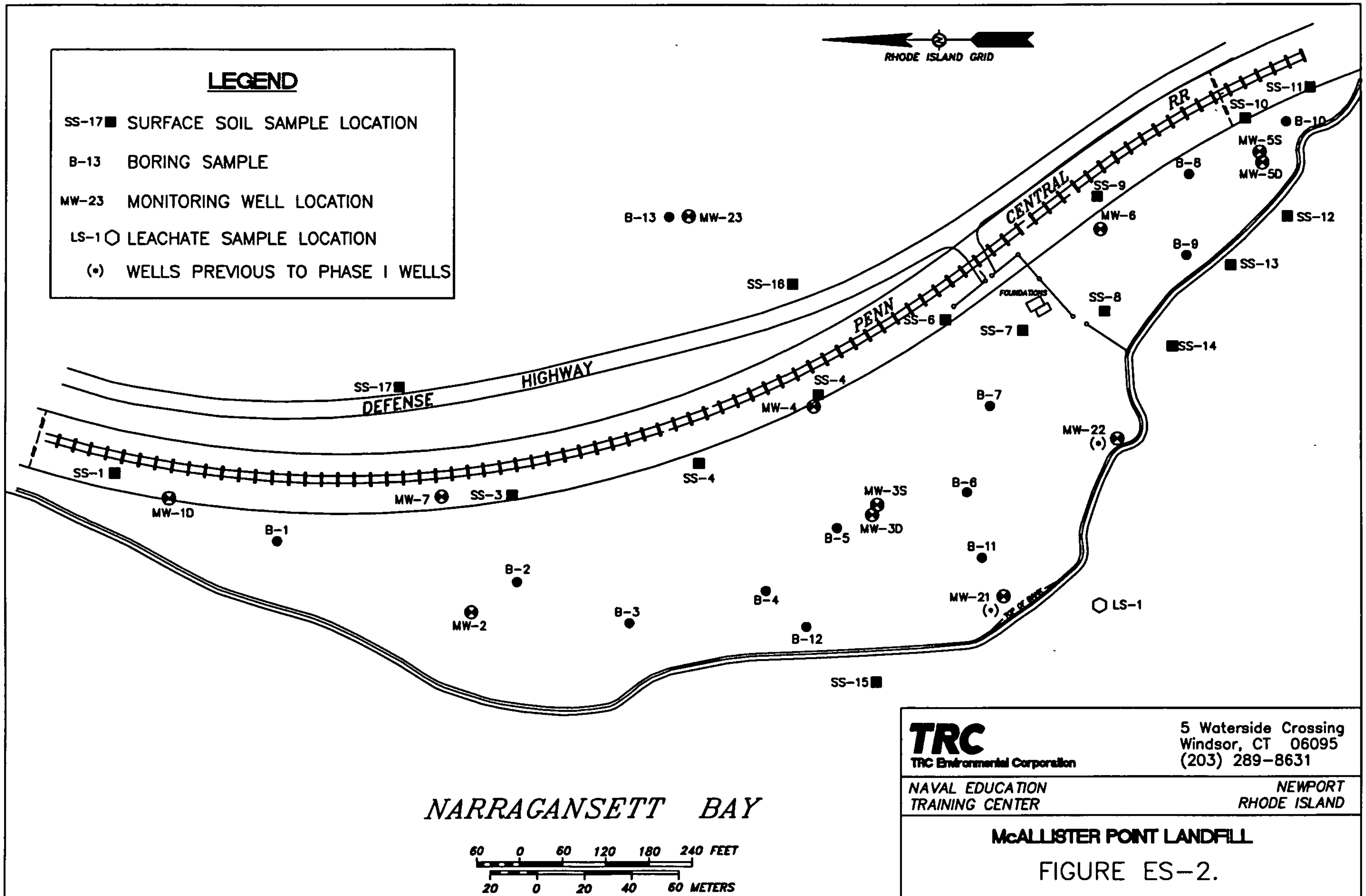
NAVAL EDUCATION & TRAINING CENTER		NEWPORT RHODE ISLAND	
SITE 01 McALLISTER POINT LANDFILL FIG. ES-1 SITE TOPOGRAPHIC MAP			
		SCALE 1"=50'	PROJ. NO.
DRAWN	RFM	DATE MAY 28, 1993	DWG. NO.
APPROVED			



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NAVAL EDUCATION TRAINING CENTER — *NEWPORT RHODE ISLAND*

McALLISTER POINT LANDFILL

FIGURE ES-2.

PHASE I INVESTIGATION SUMMARY

Date: 7/93 — Drawing No. 14300-N41

NOTE: SURFACE SOIL SAMPLES SS-12, SS-13, SS-14 AND SS-15 WERE COLLECTED ALONG THE SHORELINE OF THE SITE. LEACHATE SEEP SAMPLE LS-1 WAS COLLECTED FROM THE SEAWARD EMBANKMENT OF THE SITE.

TABLE ES-1
COMPARISON AMONG ALTERNATIVES
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
FOCUSED FEASIBILITY STUDY
SOURCE CONTROL
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

ACTION	DESCRIPTION
Alternativ 1 – No Action	Least protective alternative; No control of potential exposures to site-related contamination is provided; Does not comply with ARARs; Not effective in the short-term or long-term
Alternativ 2 – Fencing, Surface Controls and Deed Restrictions	Provides a limited degree of protection of human health and the environment by improving existing site conditions to limit potential migration of contamination and by limiting potential exposures through site fencing and deed restrictions; Does not comply with ARARs; Effective in the short-term but does not provide the long-term effectiveness offered by Alternatives 3 and 4
Alternative 3 – RCRA Subtitle D Soil Cap with Surface and Institutional Controls	Provides protection of human health and the environment by providing a physical barrier to exposures to surficial contamination while also limiting potential exposures through institutional controls; Does not comply with ARARs; Effective in the short-term and long-term; Provides some protection against infiltration of precipitation
Alt rnative 4 – RCRA Subtitle C Multi-Layer Cap with Surface and Institutional Controls	Provides protection of human health and the environment by providing a physical barrier to exposures to surficial contamination and to potential infiltration of precipitation and associated leaching of contamination to the ground water; Also limits potential exposures through institutional controls; Complies with ARARs; Effective in the short-term and long-term; The multi-layer design provides extra protection against infiltration

TABLE ES-2
COMPARISON AMONG ALTERNATIVES
OVERALL COMPLIANCE WITH ARARs/TBCs
FOCUSED FEASIBILITY STUDY
SOURCE CONTROL
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

ACTION	CHEMICAL-SPECIFIC	LOCATION-SPECIFIC	ACTION-SPECIFIC
Alternative 1 – No Action	Not Applicable	Does not comply with wetlands or floodplain requirements.	Not Applicable
Alternativ 2 – Fencing, Surface Controls and Deed Restrictions	Not Applicable	Does not comply with wetlands or floodplain requirements.	Does not comply with federal or state landfill closure ARARs; Drainage improvements would be designed in accordance with storm water discharge requirements
Alternative 3 – RCRA Subtitle D Soil Cap with Surface and Institutional Controls	Not Applicable	Cap construction would comply with floodplain construction and coastal zone regulations.	Cap does not comply with federal hazardous waste landfill closure ARARs.
Alternative 4 – RCRA Subtitle C Multi-Layer Cap with Surface and Institutional Controls	Not Applicable	Cap construction would comply with floodplain construction and coastal zone regulations.	Cap would comply with state and federal hazardous waste and municipal solid waste landfiill closure ARARs.

TABLE ES-3
COMPARISON AMONG ALTERNATIVES
LONG-TERM EFFECTIVENESS AND PERMANENCE
FOCUSED FEASIBILITY STUDY
SOURCE CONTROL
SITE 01 - McALLISTER POINT LANDFILL
NETC - NEWPORT, RI

ACTION	DESCRIPTION
Alt mativ 1 - No Action	Existing site-related risks remain; No controls implemented to limit potential exposures to site contamination; Requires a five-year review
Alt rnative 2 - Fencing, Surface Controls and Deed Restrictions	Relies on institutional controls and minor site improvements to limit exposures to site contamination; Access to contamination along shoreline may be difficult to restrict; Requires a five-year review
Alternative 3 - RCRA Subtitle D Soil Cap with Surface and Institutional Controls	Containment of contamination is provided through the physical barrier of a soil cap but residual risk remains due to the continued presence of the landfilled wastes; Effective in the long-term in limiting potential physical exposures to surficial contamination but is not as effective as Alternative 4 in limiting potential infiltration of precipitation or leachate seeps through the side slope of the landfill; Requires a five-year review
Alternative 4 - RCRA Subtitle C Multi-Layer Cap with Surface and Institutional C ntrols	Containment of contamination is provided through the physical barrier of a multi-layer cap but residual risk remains due to the continued presence of the landfilled wastes; Effective and reliable in the long-term in limiting potential physical exposures to surficial contamination as well as minimizing infiltration of precipitation or leachate seeps through the surface or side slope of the landfill; The multi-layer design enhances the reliability of the cap in preventing infiltration; Requires a five-year review

TABLE ES-4
COMPARISON AMONG ALTERNATIVES
REDUCTION IN TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT
FOCUSED FEASIBILITY STUDY
SOURCE CONTROL
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

ACTION	DESCRIPTION
Alternative 1 – No Action	No reductions in toxicity, mobility or volume achieved
Alt rnative 2 – Fencing, Surface Controls and Deed Restrictions	While no treatment is provided, a slight reduction in the potential mobility of site-related contamination may be achieved through limited site improvements
Alt rnativ 3 – RCRA Subtitle D Soil Cap with Surface and Institutional Controls	While no treatment or destruction of contamination is provided, a reduction in the potential mobility of site-related contamination via control of surface erosion and a reduction in the infiltration of precipitation will be achieved through implementation of a soil cap
Alt rnativ 4 – RCRA Subtitle C Multi-Layer Cap with Surface and Institutional Controls	While no treatment or destruction of contamination is provided, a reduction in the potential mobility of site-related contamination via control of surface erosion, infiltration of precipitation and leachate seepage will be achieved through implementation of a multi-layer cap

TABLE ES-5
COMPARISON AMONG ALTERNATIVES
SHORT-TERM EFFECTIVENESS
FOCUSED FEASIBILITY STUDY
SOURCE CONTROL
SITE 01 - McALLISTER POINT LANDFILL
NETC - NEWPORT, RI

ACTION	DESCRIPTION
Alt rnativ 1 - No Action	No remedial activities conducted; Therefore, no short-term risks result; Remedial response objectives not achieved
Alternative 2 - Fencing, Surface Controls and Deed Restrictions	Minimal short-term risks associated with fence construction and limited surface improvements; Short implementation time frame; Remedial response objectives not achieved
Alternative 3 - RCRA Subtitle D Soil Cap with Surface and Institutional Controls	Potential risks associated with cap construction and fence installation can be minimized through personnel protective equipment; Short-term increases in local traffic could occur as a result of during transporting cap materials to the site; Remedial response objectives are achieved
Alt rnativ 4 - RCRA Subtitle C Multi-Layer Cap with Surface and Institutional Controls	Short-term effectiveness is comparable to Alternative 3; Potential risks associated with cap construction and fence installation can be minimized through personnel protective equipment; Short-term increases in local traffic could occur as a result of transporting cap materials to the site; Requires the longest time to implement due to the comlexity of the cap design; Remedial response objectives are achieved

TABLE ES-6
COMPARISON AMONG ALTERNATIVES
IMPLEMENTABILITY
FOCUSED FEASIBILITY STUDY
SOURCE CONTROL
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

ACTION	DESCRIPTION
Alternative 1 – No Action	Requires no implementation other than a five–year review; Would not limit the implementation of other remedial actions
Alternative 2 – Fencing, Surface Controls and Deed Restrictions	Easily implemented; Would not limit the implementation of other remedial actions
Alt rnative 3 – RCRA Subtitle D Soil Cap with Surface and Institutional Controls	Relatively easy to implement, requiring commonly used equipment and construction materials and techniques; Location of sufficient volumes of low permeability material for barrier layer may be difficult; Requires extensive site preparation prior to construction; Existing slope along Narragansett Bay may cause difficulties in cap construction in this area of the site; Not a significant barrier to the implementation of other remedial actions.
Alternative 4 – RCRA Subtitle C Multi–Layer Cap with Surface and Institutional Controls	More difficult to implement than Alternative 3, requiring special equipment and materials for geomembrane installation and extra care in placement of overlying cap materials to prevent puncture of the geomembrane; Location of sufficient volumes of low permeability material for barrier layer may be difficult; Requires extensive site preparation prior to construction; Existing slope along Narragansett Bay may cause difficulties in cap construction in this area of the site; Additional site investigations to be conducted to support design activities and to allow for the consideration of other remedial actions in the cap design process, with complementary design features integrated into the final design, as applicable, thereby enhancing the implementation of the final remedy for the site without compromising the integrity of the cap

TABLE ES-7
COMPARISON AMONG ALTERNATIVES
COST
FOCUSED FEASIBILITY STUDY
SOURCE CONTROL
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

ACTION	TOTAL CAPITAL COST	ANNUAL O&M COST	PRESENT WORTH O&M COST [1]	TOTAL PRESENT WORTH [2]
Alternative 1 – No Action	--	--	--	Nominal [3]
Alternative 2 – Fencing, Surface Controls and Deed Restrictions	$190,000	$19,000	$290,000	$580,000
Alternative 3 – RCRA Subtitle D Soil Cap with Surface and Institutional Controls	$2,500,000	$150,000	$2,300,000	$5,800,000 [4]
Alternative 4 – RCRA Subtitle C Multi-Layer Cap with Surface and Institutional Controls	$4,300,000	$150,000	$2,300,000	$8,000,000 [4]

(1) – Based on 5% discount rate
(2) – Includes 20% contingency on all components
(3) – The only cost associated with the implementation of Alternative 1 would be that associated with conducting a five-year review of the no action decision.
(4) – Additional costs could be incurred if landfill gas treatment is required.

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Table

1.0 INTRODUCTION

At the request of the U.S. Navy, TRC Environmental Corporation (TRC) is conducting a Focused Feasibility Study (FFS) at Site 01 - McAllister Point Landfill, at the Naval Education and Training Center (NETC), Newport, Rhode Island. The FFS is being conducted under the Navy's Installation Restoration Program and in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA). The study is being performed by TRC under contract N62472-86-C-1282.

Four sites at the NETC facility, including Site 01 - McAllister Point Landfill, Site 09 - Fire Fighting Training Area, Site 12 - Tank Farm Four, and Site 13 - Tank Farm 5, are being investigated under a Remedial Investigation/Feasibility Study (RI/FS) program. A Phase I Remedial Investigation (RI) has been conducted to investigate the physical characteristics of the sites (referred to herein as RI/FS sites), as well as to identify potential sources of contamination, determine the nature and extent of contamination, and characterize potential health risks and environmental impacts. Detailed site background information, results of the investigations, and a characterization of the potential risks to human health and the environment posed by the sites are presented in a report entitled Remedial Investigation Technical Report (TRC, 1991). Additional investigations of these sites (Phase II) are currently being planned.

Based on a review of the potential human health and environmental risks posed by the various contaminated media at the NETC sites (as identified by the Phase I investigations), source control at McAllister Point Landfill was determined to be a high priority. Therefore, to expedite the decision making process and reduce the overall time frame required to clean up the site, it was determined that the preparation of a Focused Feasibility Study addressing source control at Site 01 - McAllister Point Landfill was appropriate. This decision process is discussed further in Section 3.1.

The purpose of the FFS is to identify and evaluate alternatives which are applicable to providing source control at the site. By evaluating remedial solutions selected from the range of technologies available for cleanup, a response can be formulated which is technically feasible, protects public health and the environment, is cost-effective, and is consistent with applicable or relevant environmental standards. Any remaining contaminated environmental media at

McAllister Point Landfill not addressed by this FFS will be addressed within a separate Feasibility Study.

The Feasibility Study process was formulated by the U.S. Environmental Protection Agency (EPA) to properly implement CERCLA. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 CFR Part 300) establishes a framework for performing Feasibility Studies. Further definition of the FS process is provided in the Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (U.S. EPA, Interim Final, October 1988). Site-specific guidance for the FS process at landfills can be found in the document entitled Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites (U.S. EPA, February 1991).

The first section of this FFS presents general background information on the history, geology, and hydrogeology of the NETC facility. After the description of the NETC facility as a whole, a description of McAllister Point Landfill, its site history, and results of previous site investigations is presented. The site geology and hydrogeology of McAllister Point Landfill are described in detail. Finally, a summary of contaminant fate and transport and the human health risk assessment is presented.

Section 2 presents the identification and screening of final source control remedial actions considered for the site. In this section, remedial action objectives are developed along with general response actions. The technologies and process options associated with the remedial response actions are briefly described and screened, initially on the basis of technical implementability and then on the basis of effectiveness, implementability and cost. On the basis of this screening, remedial alternatives are developed. For a Focused Feasibility Study, a limited number of alternatives is considered.

Section 3 defines the remedial alternatives and provides an evaluation of the alternatives according to the criteria specified by the NCP. This section also includes a comparative analysis of the different alternatives.

Section 4 provides conclusions and recommendations for conducting a final source control remedial action at the site.

References are provided in Section 5.

1.1 NETC Background

This section presents a general review of the history, geology, and hydrogeology of the NETC facility, also referred to as the Newport Naval Base. Extensive information regarding these areas has already been presented in previous site reports, including the Initial Assessment Study (IAS, Envirodyne Engineers, 1983), Confirmation Study (CS, Loureiro Engineering Associates, 1986), and Remedial Investigation Technical Report (TRC, 1991).

1.1.1 History of the NETC

NETC is located north of Newport, Rhode Island, on the west shore of Aquidneck Island facing the east passage of Narragansett Bay (see Figure 1-1). The following paragraphs present a summary of the history of the facility; additional detail is provided in the IAS (pp. 5-6 to 5-14).

The Newport area was first used by the Navy during the Civil War when the Naval Academy was moved from Annapolis, Maryland to Newport in order to protect it from Confederate troops. After the war, the Naval Academy returned to Annapolis. The first permanent Navy use of the area was in the 1880s when the Naval War College was established on Coasters Harbor Island. The outbreak of World War I brought a significant increase in military activity to Newport, including an increase in the number of men stationed at Newport and the number of ships entering port. Activity slowed after WWI until the onset of WWII. Reactivation of the base occurred in the late 1930s as a result of a military build-up in Europe. Following WWII, naval activities at Newport converted to peacetime status. In 1946, the entire naval complex was consolidated into a single naval command.

The Naval Base adjusted to peacetime status by increasing its activities in the fields of research and development, specialized training, and preparedness for modern warfare. In 1952, the U.S. Naval Station and the U.S. Naval Schools Command were established. McAllister Point Landfill opened in 1955. Newport became the headquarters of the Commander Cruiser-Destroyer Force Atlantic in 1962. In July of 1971, the Naval Schools Command was restructured and named the Naval Officer Training Center (NOTC) which became the Naval Education and Training Center (NETC) in 1974. In April of 1973, the Shore Establishment Realignment program (SER) was announced and resulted in the largest reorganization of Naval forces in the Newport area. The fleet stationed at Newport was relocated and several naval activities were disestablished. The reorganization brought about by the SER resulted in the Navy excessing some 1,629 of its 2,420 acres.

In November 1989, the entire NETC was listed on the U.S. EPA's National Priorities List (NPL) of abandoned or uncontrolled hazardous waste sites.

1.1.2 **Regional Physiography**

Presented in this section is a discussion of climate, terrestrial features, and marine features as they relate to the NETC facility and surrounding area. The information from this section has been summarized from the IAS, as noted. Additional site-specific studies regarding terrestrial and marine features will be performed under the Phase II Remedial Investigation.

Climate - The climate at the NETC facility is greatly influenced by its proximity to Narragansett Bay and the Atlantic Ocean, which tend to moderate the area's temperatures. Winter temperatures are somewhat higher and summer temperatures somewhat lower than inland areas. The average annual precipitation for the area is 42.75 inches, and measurable precipitation (0.01 inch or greater) occurs on about one day out of three. Severe weather in the form of tropical cyclones and hurricanes is a serious threat in the NETC area. The probability that a tropical cyclone will invade the area is one in five in any year, while the probability of hurricane force winds invading the area is less than one in fifteen in any year. (IAS, pp. 5-14 to 5-15)

Terrestrial Features - The topography of the NETC area was shaped by the bedrock geology, glaciation, and recent erosion. The bedrock geology controlled the locations of the ancient river valleys, which were gouged out of the bedrock by glaciers. The hills are cored by bedrock highs. A mantle of poorly sorted till, an average of 20 feet thick, was spread over the bedrock during the Wisconsin glaciation. As the glaciers melted, ocean levels rose and flooded the river valleys, forming the passages of Narragansett Bay.

There are five basic types of soils at the NETC: mucks, beaches, loams, sands, and urban complexes. The mucks are found in tidal flats and inland depressions which hold ponded water. Loams (mixtures of sand, silt, clay, and organic matter) and sands are found in upland areas on-site and generally drain rapidly. Urban complexes are mixtures of natural soils, imported soils, and urban materials.

The flora and fauna of the NETC are strongly influenced by human activity. The upland vegetation within the NETC is restricted primarily to perennial weeds and grasses. The habitats available for lowland vegetation are located on the waterfront along Narragansett Bay and surrounding the small impoundments and their drainage further inland. Those areas located on the waterfront are comprised of borrow pits along the railroad tracks and abandoned disposal areas where excavation has created depressions. Borrow pits can be found along the railroad tracks which parallel the shoreline extending from McAllister Point northward to Melville North Landfill. All lowlands at the NETC have been artificially created and are in a disturbed condition. The potential for maintaining diversified floral species within the lowlands is poor.

The fauna of the region have also been affected by area disturbances (e.g., from clearing, excavation, construction). Field studies have indicated impoverished fauna, particularly of herptile and mammal types. Widespread habitat destruction over a period of several hundreds of years has caused emigration or elimination of many species. As a result, the present regional fauna consist primarily of species of wide distribution and ecological tolerances, high adaptability, and nonrestrictive habitat requirements. (IAS, pp. 5-37 to 5-39)

<u>Marine Features</u> - Narragansett Bay occupies three former river valleys which were submersed by the advance of the Atlantic Ocean. Narragansett Bay is 20 miles long and 11 miles wide. The bay has a surface area of 102 square miles. The average depth of the bay is 30 feet. The eastern passage, which the NETC fronts, allows deep water access up to the south end of Prudence Island. Channel depth exceeds 80 feet in the eastern passage from Gould Island seaward, and depths in excess of 150 feet occur near the mouth of the bay.

The sediments in the bay are contaminated with heavy metals, hydrocarbons, and sewage sludge (Master Plan, Naval Facilities Engineering Command, Northern Division, 1980). A survey conducted by the U.S. EPA (U.S. EPA, 1975) identified the presence of heavy metal concentrations in the sediments in interstitial waters north of the Naval Complex. These contaminants are the result of industrial and municipal discharges into the bay. (IAS, pp. 5-28, 5-31)

The marine ecosystem of Narragansett Bay forms the shoreline of the base for approximately 9 miles. The bay is of great economic and aesthetic importance to the entire southern portion of Rhode Island. It is an estuary and the fishery resources of the bay are extremely important. The annual value of the combined commercial and sport fishing is estimated at several million dollars. Shellfishing areas open to the public do not include the NETC shoreline. (IAS, pp. 5-40 to 5-47)

1.1.3 **Regional Geology**

The NETC facility is located at the southeastern end of Narragansett Basin. The basin is a complex synclinal mass of Pennsylvanian-aged sedimentary rocks and is the most prominent geologic feature in eastern Rhode Island and adjacent Massachusetts. The Narragansett Basin is an ancient north to south trending structural basin originating near Hanover, Massachusetts. The basin has a length of approximately 55 miles and varies in width from 15 to 25 miles. The western margin of the basin lies in the western portion of Providence, Rhode Island, and the eastern margin runs through Fall River, Massachusetts. Exposures of older rocks on Conanicut Island and in the vicinity of Newport suggest that the southern extent of the basin is near the mouth of Narragansett Bay.

The bedrock of the Narragansett Basin has been divided into the following five units: the Rhode Island Formation, Dighton Conglomerate, Wansulta Formation, Pondville Conglomerate, and Felsite at Diamond Hill. At NETC and in most of the surrounding area, the bedrock is entirely of the Rhode Island Formation. Included within the Rhode Island Formation are fine to coarse conglomerate, sandstone, lithic graywacke, graywacke, arkose, shale, and a small amount of meta-anthracite and anthracite. Most of the rock is gray, dark gray, and greenish, but the shale and anthracite are often black.

Overlying the Pennsylvanian rocks of the Narragansett Basin are surficial deposits of Pleistocene sediments. These Pleistocene sediments owe their origin to the Wisconsin glaciation which covered the area with ice several thousand feet thick. As the glaciers receded some 10,000 to 12,000 years ago, they deposited unconsolidated glacial materials of variable thickness throughout the Narragansett Basin area. The unconsolidated glacial material ranges in thickness from 1 to 150 feet, being thicker in the valleys and thinner in the uplands. The glacial material consists of till, sand, gravel, and silt. The glacial materials serve as the parent for the soils in the area. (IAS, pp. 5-18, 5-21)

1.1.4 **Regional Hydrology**

Regional Surface Water Hydrology - NETC is located within the Narragansett Bay Drainage Basin. This drainage basin covers an area of 1,850 square miles, 1,030 square miles of which are in Massachusetts and 820 square miles of which are in Rhode Island. All surface water drainage from the basin flows into Narragansett Bay. Three major rivers, the Taunton, Blackstone, and Pawtucket, as well as the Providence River and a number of smaller rivers and streams, drain into Narragansett Bay. Discharge from Narragansett Bay is into the Atlantic Ocean between Point Judith and Sakonnet Point in Rhode Island. (IAS, pp. 5-26, 5-28)

The potential for pollutant migration by surface drainage at NETC is greatly increased by its proximity to Narragansett Bay. Several historic waste disposal areas, such as the McAllister Point Landfill, are located along the shoreline of Narragansett Bay. Surface drainage from these areas is directly into the bay. The NETC area is frequently subjected to thunderstorms during which intense periods of rainfall are common. Surface drainage into the bay would be greatest following these thunderstorms. (IAS, pg. 5-34)

Regional Surface Water Classifications - The surface water quality classifications for Narragansett Bay, as determined by the Rhode Island Department of Environmental Management (RIDEM), are shown on Figure 1-2. Most of Narragansett Bay is classified as Class SA, which means it is suitable for bathing and contact recreation, shellfish harvesting for direct human consumption, and fish and wildlife habitat.

Areas classified as Class SB are suitable for public drinking water with appropriate treatment, agricultural uses, bathing, other primary contact recreational activities, and fish and wildlife habitat. Areas classified as Class SC are suitable for boating, other secondary contact recreational activities, fish and wildlife habitat, industrial cooling, and good aesthetic value.

Two freshwater streams located on NETC property have been classified as Class B surface waters. Class B surface waters are suitable for public water supply with appropriate treatment, agricultural uses, bathing, other primary contact recreational activities, and fish and wildlife habitat.

Area Water Use - Public water in the City of Newport and town of Middletown is supplied and managed by the Newport Water Department. The Town of Portsmouth purchases water from the Newport Water Department, but operates its own distribution system. Approximately two-thirds of Portsmouth is serviced by public water while the remaining one-third is supplied water from private water wells. While no specific records exist as to private well use in the information reviewed, the majority of private wells are reportedly located on the eastern portion of Aquidneck Island (Personal Communication, Town of Portsmouth, 1992).

The Newport Water Department receives its water supply from a series of seven surface water reservoirs located on Aquidneck Island and two surface water reservoirs on the mainland. Each of the reservoirs is supplied water via rainfall and runoff and is not augmented by ground water supply wells. Figure 1-3 indicates the location of surface water reservoirs and public ground water supply wells in the vicinity of Newport Naval Base. The locations of ground water supply wells were obtained from the February 1992 RIDEM Ground Water Section Facilities Inventory Map for the Prudence Island Quadrangle (USGS). This map shows the locations of known public ground water supply wells, in addition to the locations of known or suspected sources of ground water contamination. The location of the supply wells within the Prudence Island Quadrangle reportedly have been field verified by RIDEM personnel.

1.1.5 Regional Ground Water Hydrogeology

Ground water on Aquidneck Island is obtained from the unconsolidated glacial deposits of till and outwash and from the underlying Pennsylvanian bedrock. Throughout the area, depth to ground water ranges from less than one foot to about 30 feet, depending on the topographic location, time of year, and character of subsurface deposits. The average depth to ground water is about 14 feet on Aquidneck Island; the ground water moves from areas of high elevations to Narragansett Bay or the Sakonnet River.

The unconsolidated glacial deposits range in thickness from less than one foot near the rock exposures to about 50 feet throughout Aquidneck Island. In the NETC area, the glacial deposits are characterized as till with a thickness of less than 20 feet. The yield of wells completed in the till varies considerably depending upon the type and thickness of the water-bearing deposits penetrated. Under normal conditions, till wells yield a few hundred gallons of water per day and are adequate for domestic supplies. Wells completed within the till typically consist of dug wells.

Bedrock wells in the area range from 14 to 1,300 feet in depth with an average depth of about 135 feet. Most bedrock wells yield less than 10 gallons per minute. The yields vary considerably in the bedrock over short distances because the joints and fractures which transmit water to the wells occur intermittently. Joints and fractures are most numerous and widest near the top of the bedrock and become fewer and narrower with depth. (IAS, pp. 5-31 to 5-34)

The ground water at the NETC is very shallow; the water table lies less than 10 feet below the ground surface in most areas. This shallow depth to water increases the potential for ground water contamination at the NETC. Those pollutants which do find their way into the ground water could migrate to the west and discharge into Narragansett Bay. As the NETC extends along the western shoreline of Aquidneck Island, the on-site ground water has to migrate only a short distance before discharging into Narragansett Bay.

The soils occurring at the NETC have permeabilities which are moderate to moderately rapid, and they do not restrict the vertical movement of water. The glacial till, from which these soils were derived, is generally less permeable than the overlying soils but does not represent a barrier to the vertical migration of water. Therefore, it is possible that any contaminant transported in infiltrating surface or near-surface water could reach the ground water. There are also isolated bedrock outcrops at the ground surface. Ground water contamination is possible in these areas via the cracks and fissures which commonly occur in the bedrock. (IAS, pg. 5-34)

Information obtained from the Phase I RI indicated that, in general, ground water at the NETC flows from east to west towards Narragansett Bay. Measured depth to ground water ranged from approximately 4 to 28 feet below the ground surface at the four RI/FS sites. Slug tests conducted on monitoring wells at these sites indicated that the hydraulic conductivity of the till unit ranged from 0.22 to 0.44 feet per day (ft/day) and the upper bedrock hydraulic conductivity ranged from 0.029 to 0.21 ft/day. The RI report noted that bedrock test data produced hydraulic conductivities that were higher than those normally attributed to unweathered/unfractured shale (3.28×10^{-8} to 3.28×10^{-4} ft/day, Driscoll, 1987).

Ground Water Classifications - RIDEM has classified ground water in Rhode Island to protect and restore the quality of the state's ground water resources for use as drinking water and other beneficial uses, and to assure protection of the public health and welfare and the environment. The ground water at the NETC facility ranges in classification from GA-NA to GB, as shown on Figure 1-3.

Ground water classified as GA is known or presumed to be suitable for drinking water without treatment. Ground water classified as GB may not be suitable for drinking water without treatment due to known or presumed degradation. GB classified ground water is primarily located at highly urbanized areas or is located in the vicinity of disposal sites for solid waste, hazardous waste or sewerage sludge.

Non-attainment (NA) applies to those areas which are known or presumed to be out of compliance with the standards of the assigned classification. The goal for non-attainment areas is restoration to a quality consistent with the assigned classification.

1.2 Background Information

1.2.1 Site Description

McAllister Point Landfill is located in the central portion of the NETC facility (see Figure 1-4). The site covers approximately 11.5 acres and is situated between Defense Highway and Narragansett Bay. Penn Central Railroad tracks run in a north-south direction along the eastern side of the site, parallel to Defense Highway. Access to the site is from Defense Highway, across the railroad tracks, and through a gate in the south-central portion of the site. A site map is presented as Figure 1-5.

Grass, weeds, and some small trees cover most of the site. A small, lightly wooded area exists in the north-central portion of the site. A more mature wooded area is located just off the northeastern edge of the site between the railroad tracks and Defense Highway. In the central portion of the site, several depressions are present where standing water collects during heavy precipitation events. Ground elevations across the main portion of the site vary between approximately 15 and 35 feet above mean low water level (MLW). Along the western edge of the site, the grade drops off quickly to the shoreline, changing by as much as 20 feet. Metal debris and concrete rubble are present along the shoreline of the landfill and appear to have decreased the potential for erosion of the landfill slopes. A topographic map of the site is provided in Figure 1-5.

1.2.2 Site History

McAllister Point Landfill was the site of a sanitary landfill which operated over a 20-year period. From 1955 until the mid-1970s, the site accepted all wastes generated at the naval complex. The landfill received waste from all operational areas (machine shops, ship repair, Naval Underwater Systems Center (NUSC), etc.), Navy housing areas (domestic refuse), and from the 55 ships homeported at Newport prior to 1973 (approximately fourteen 40-cubic yard containers each day). The materials reportedly disposed of at the site included spent acids, paints, solvents, waste oils (diesel, lubrication, and fuel), and PCB-contaminated transformer oil.

A review of historic aerial photos identifies a railroad spur entering the site near the current entrance and running north into the center of the site in 1938, and large open depressions and what appear to be material storage areas and tanks in the 1940s and 1950s. From 1965 through 1975, the shoreline of the central portion of the site changes shape, indicating filling of Narragansett Bay in this area.

During the period 1955 through 1964, wastes were trucked to the site, spread with a bulldozer, and covered. In 1965, an incinerator was built at the landfill. From 1965 through 1970-71, approximately 98 percent of all the wastes were burned before being disposed of in the landfill. The incinerator was closed around 1970 as a result of the air pollution it caused. During the remaining years that the site was operational, all wastes were again disposed of directly into the landfill.

Following the closure of the landfill at McAllister Point, a three-foot-thick covering of clay/silt was reportedly placed over the site. Current observations confirm the presence of a clay/silt material over portions of the landfill, although it is not continuous over the whole landfill area. Since the closure of the landfill, the site has remained inactive.

1.3 Site Geology

The soil boring activities performed at the site under the Phase I RI, as well under previous subsurface investigations (Envirodyne Engineers, 1983 and Loureiro Engineering Associates, 1986), provided information on the site geology. Previous subsurface investigation activities included the drilling and sampling of three soil borings completed for the installation of three monitoring wells (MW-21, MW-22 and MW-23). The locations of the Phase I RI wells and borings as well as the three previous site investigation well locations are shown in Figure 1-6. From the Phase I RI subsurface investigations, three geologic cross sections were developed for the site. The locations of these cross sections are shown on Figure 1-6. The geologic cross sections are shown on Figures 1-7 through 1-9. The cross sections do not reflect Confirmation Study boring logs.

The overburden at this site consists of fill and glacial till deposits. All of the soil borings except for test boring B-13 (off-site and upgradient to the northeast) and all of the monitoring well borings, except for well MW-23 (previously installed off-site during the Confirmation Study adjacent to the location of B-13), encountered fill material. The thickness of the fill material ranged from 3 feet (M-1) near the periphery of the site, to 24 feet (M-3) in the central portion of the landfill. The boring for well MW-21, previously installed during the Confirmation Study at the western edge of the central portion of the landfill, reportedly encountered 38 feet of fill material. The fill material appears to have been deposited directly upon the bedrock surface across a majority of the site. The fill material encountered generally consisted of three broad categories of waste: domestic-type refuse, industrial/construction (demolition) waste, and incinerator ash. The central, mounded portion of the landfill was characterized by the presence of domestic-type refuse (e.g., plastic, paper, garbage). The remainder of the soil borings contained waste typical of building demolition debris (e.g., wood, metal, brick, concrete, etc.). Incinerator ash was encountered in borings in the northwestern portion of the site (B-1, B-2, B-4 and M-2) and in a single boring, B-9, in the southern part of the site. The ash was overlain by demolition-type debris at B-2, B-4, B-9 and M-2; at B-1 ash extended from 1.5 to 8 feet below grade and was the only type of waste encountered in the boring.

At several locations across the landfill, overlying the fill material is a clay-silt layer ranging in thickness from 0 to 4 feet. This layer is presumably the cover material or "cap" which was reportedly placed on-site when the landfill was closed in 1973. The cover material is discontinuous across the site, and was found primarily in the central portion of the landfill (soil borings B-3, B-4, B-5, and B-6), as indicated in Cross-Section B-B' (Figure 1-8) corresponding to the area in which domestic-type waste was identified. A clay-silt horizon was also encountered overlying the fill material in well boring M-5 and test boring B-10, both completed at the southern end of the landfill, and in B-1, completed in the northern portion of the landfill; however, this material did not appear to be the same "cap" material encountered in the central landfill area.

Glacial till deposits were observed directly beneath the fill and overlying the bedrock at the periphery of the site (at well borings M-1 and M-5, and test boring B-10), as indicated in Cross Section A-A' on Figure 1-7. Till was observed directly overlying the bedrock at the off-site location of soil boring B-13. Till was also encountered in boring B-4 in the central landfill area, and in B-8 in the southern portion of the site. These borings were completed within the till layer. The till encountered consisted primarily of fine to coarse sand and silt, with some horizons containing weathered shale fragments. The till varied in thickness from 4.5 feet (B-13) to 11.5 feet (M-5). One undisturbed Shelby tube soil sample was collected from the till at 14 to 15.5 feet below grade, near the southern end of the site (M-5). The undisturbed soil sample was tested by Empire Soils Investigations, Inc. for triaxial permeability, particle size, and Atterberg limits. The till sample was determined to have a permeability of 2.69×10^{-7} cm/sec (7.3×10^{-4} ft/day). Grain size analysis indicated the till sample consisted of 23.5% gravel, 44.6% sand, 13.4% silt, and 18.5% clay. According to its Atterberg limits, the soil sample was classified as "non-plastic", which is typical of till.

The bedrock encountered at the McAllister Point Landfill consisted of a gray-green to black, highly weathered to competent, carboniferous shale. Cores of the shale exhibited a high degree of fracturing, with quartz and iron-oxide deposits common along the fractures. All but four of the soil borings were completed to the depth of the bedrock surface. The depth to bedrock at the site varied from 4 feet (at M-7) to 24 feet (at M-3). The bedrock surface exhibits a uniform, westward slope, towards Narragansett Bay. A bedrock contour map is presented on Figure 1-10.

1.4 Site Hydrogeology

1.4.1 Surface Water Hydrology

There are no surface water bodies present on the McAllister Point Landfill site. The general site topography slopes in an east to west direction (see Figure 1-5). Surface water on the site (precipitation or runoff from surrounding higher elevations) either evaporates, infiltrates into the site soils, or flows overland to surrounding lower elevation areas or the adjacent Narragansett Bay. During periods of heavy rainfall, water collects in small depressions located in the north-central portion of the site. The western edge of the entire site, which borders Narragansett Bay, is at an elevation approximately 10 feet higher than the beach shoreline along the bay. Springs have been observed discharging from the bottom of the landfill bank along the western edge of the site, directly into the bay. A wetland determination investigation will be conducted at the site as part of additional site investigations. The Flood Insurance Rate Map (FEMA, 1984) which covers the site and surrounding area indicates the shoreline of the site lies within the 100-year coastal flood area.

1.4.2 Ground Water Hydrogeology

1.4.2.1 Water Levels and Bedrock Hydraulic Conductivities

Ground water levels were measured in the nine monitoring wells installed at the site in April, July, and September of 1990, and in January of 1991. A representative ground water table contour map is presented as Figure 1-11. The contour map indicates that the site ground water is flowing from east to west, towards Narragansett Bay. The water table, as measured in January 1991, is also plotted on the geologic cross-secitons in Figures 1-7, 1-8 and 1-9. As indicated, in portions of the site fill material is in direct contact with the water table.

Single well hydraulic conductivity tests (slug tests) were performed in four of the monitoring wells at the site (MW-1, MW-3D, MW-5D, and MW-7). All of these wells are screened within the bedrock at the site. Monitoring wells MW-1 and MW-7 are screened in the weathered upper zone of the bedrock. The hydraulic conductivities determined from the slug tests range from 0.07 ft/day (wells MW-7 and MW-3D) to 0.20 ft/day (well MW-5D). These hydraulic conductivity values are higher than values normally attributed to shale (3.28×10^{-8} to 3.28×10^{-4} ft/day) (Driscoll, 1987) and probably reflect the highly weathered and fractured nature of the upper portion of the bedrock at the site. Slug tests were not conducted in monitoring wells screened in the fill material at the site, due to the ground water levels (i.e., insufficient water) in the shallow wells.

1.4.2.2 Vertical Hydraulic Gradients

Vertical hydraulic gradients were determined at the two sets of nested shallow/deep monitoring wells at the site (MW-3S/D and MW-5S/D). Vertical hydraulic gradients are used to evaluate whether contamination can migrate downward through an aquifer. A positive hydraulic gradient will result in an upward flow, and a negative gradient will result in a downward flow. A positive vertical gradient would tend to retard contaminant transport down through an aquifer, whereas a negative vertical gradient would allow for contaminant migration toward the bottom of the aquifer. On all four of the dates that water levels were measured, a downward, or negative, hydraulic gradient was observed in both of the well pairs. The calculated vertical gradients expressed as change of hydraulic head in feet per vertical foot of travel through the medium (ft/ft) ranged from -0.115 ft/ft (MW-3S/D on 4/3/90) to -0.242 ft/ft (MW-3S/D on 9/20/90). This indicates that ground water from above the bedrock surface (in the fill or overburden) could flow downward into the bedrock at these two locations.

1.4.2.3 Horizontal Hydraulic Gradients

Horizontal hydraulic gradients were also determined using the water level measurements at the site. Horizontal hydraulic gradients are used, along with the aquifer hydraulic conductivity and effective porosity, in determining horizontal ground water flow velocities, and hence the rate at which an aquifer may horizontally transport contaminant solutes. Horizontal hydraulic gradients were calculated for the shallow wells (screened in the fill and overburden materials), and the three deep wells (screened in bedrock) at the site on the basis of the average of the four sets of ground water level measurements taken at the site. The horizontal gradient represents the change in hydraulic head, measured in feet, per horizontal foot of travel through the medium.

Calculated shallow average horizontal hydraulic gradients ranged from 0.0056 ft/ft (MW-5S to MW-6) to 0.038 ft/ft (MW-4 to MW-3S). Deep average horizontal gradients were calculated to be 0.0077 ft/ft (MW-5D to MW-3D) and 0.0049 ft/ft (MW-3D to MW-1).

1.4.2.4 Tidal Influence

Continuous ground water level measurements were recorded in five of the monitoring wells at the site (MW-1, MW-3S, MW-3D, MW-5S, and MW-5D) for three days (August 21 to August 24, 1990). Ground water levels were recorded every 15 minutes during the three-day time period. At the same time, continuous surface water levels were recorded at a gauging station located in Narragansett Bay, adjacent to the site.

Tidal influences were observed in each of the monitoring wells except MW-3S. The influences upon monitoring wells MW-3D and MW-5S were small enough to be considered negligible. The strongest tidal influence was encountered in monitoring well MW-5D. The piezometric water level in MW-5D fluctuated by as much as 2.12 feet between high and low tide. In general, tidal influence was much stronger in the deep wells than the shallow wells. The water level fluctuations in the wells paralleled the six hour tidal period observed in the Narragansett Bay tidal station adjacent to the site. The amount of tidal fluctuation appears to be a function of proximity to Narragansett Bay and the transmissivity and storativity of the aquifer screened by the wells.

1.5 Nature and Extent of Contamination

The nature and extent of contamination at McAllister Point Landfill has been identified on the basis of site investigations, as described below.

1.5.1 Initial Assessment and Confirmation Studies

An Initial Assessment Study (IAS) was conducted at the site in 1983. The IAS (Envirodyne Engineers, 1983) identified sites at the NETC where contamination was suspected to exist and which may pose a threat to human health or the environment. Based upon historic use of the site as a landfill and the potential contaminant migration pathways at the site, McAllister Point Landfill was identified within the IAS as an area of potential concern requiring a Confirmation Study (CS).

The CS (Loureiro Engineering Associates, 1986), conducted on the site from 1984 to 1985, consisted of two phases, the Verification and Characterization Steps. During the Verification Step of the CS, sediment and mussel samples from Narragansett Bay (including background samples), leachate samples, and one composite surface soil sample from the site were collected. Five sediment samples were collected about 25 feet off-shore in one to three feet of water. Five mussel samples were collected in the intertidal zone shoreward of the sediment sampling points. Six surface soil samples were composited into one sample for chemical analysis. Two observable leachate discharges were sampled in wet weather immediately following a period of heavy rainfall; one of the leachate sample locations was also sampled in dry weather. Sample locations are shown on Figure 1-12.

Control samples of sediment and mussels were also collected at each of two locations in Narragansett Bay. These locations were selected on the basis of offering similar abiotic factors, of not being close to any point sources of pollution, and yet being close enough to the Verification Step investigation sites so that biota and sediments would be exposed to similar estuarine conditions as the samples collected at the sites being investigated. The differences in analytical results between control samples and site-specific samples were then evaluated to determine the potential environmental impact of the sites. The control samples were collected at a point north of McAllister Point, along the western shoreline opposite from Sandy Point, and at a location along the eastern edge of Conanicut Island south of the site.

During the second phase of the CS, the Characterization Step, seven sediment samples were collected, two verifying the results at previous sampling locations and the remaining samples extending the area of sampling to the south and into the bay to the southwest of the site. Three mussels samples were also collected in the intertidal zone along the southwestern shore of the site. Two downgradient monitoring wells were installed as well as one upgradient off-site monitoring well. These wells were each sampled on four occasions as part of Characterization Step investigations. See Figure 1-13 for sample locations.

A Summary of Verification Step analytical results is presented in Table 1-1, while Confirmation Step results are summarized in Table 1-2. Analysis of the composite surface soil sample indicated that low levels of inorganic contamination may be associated with the landfill cap material. Leachate spring samples from the western edge of the landfill exhibited cadmium, chromium, and cyanide, generally at concentrations less than 100 parts per billion (ppb). Ethylbenzene (30 ppb) and toluene (26 ppb) were also detected in one leachate sample. The sediment samples indicated the presence of inorganic contaminants in samples collected adjacent to the site, especially near the southern end of the landfill, with levels decreasing with increased distance from the site, as indicated in Table 1-3. Inorganics were also present in mussel samples. Polychlorinated biphenyls (PCBs), which were detected in mussel samples but not in sediment samples, did not appear to be site-related on the basis of the detection of levels in the control (background) mussel samples (0.36 and 0.37 $\mu g/g$) which were similar to near-site levels (non-detectable to 0.38 $\mu g/g$). Site ground water samples exhibited elevated levels of metals. The analytical results from the sampling are provided in the Confirmation Study Final Report (Loureiro Engineering Associates, 1986).

1.5.2 U.S. Army Corps of Engineers Study

In early March 1988, the Water Quality Laboratory Engineering Division of the U.S. Army Corps of Engineers (ACOE) collected a series of six sediment and mussel samples in Narragansett Bay near McAllister Point Landfill, as shown on Figure 1-14. A seventh set of samples was collected at a location approximately 300 feet north of the site as a control sample. The sediment samples were analyzed for total petroleum hydrocarbons (TPH), PCBs, and six metals (cadmium, chromium, copper, nickel, lead, and zinc). The mussel samples were also analyzed for the same six metals. The sediment sample results indicated the presence of TPH at concentrations from 30 parts per million (ppm) to 1,100 ppm, PCBs from 0.01 ppm to 20.3 ppm, and the presence of elevated levels of metals. Concentrations in sediment samples collected adjacent to the landfill were generally at least one order of magnitude greater than concentrations in the control sample. Copper, chromium, zinc and PCBs were detected in some of the mussel samples at concentrations greater than were detected in the control sample.

1.5.3 **Phase I Remedial Investigation**

The Phase I RI, conducted from 1989 to 1990, included site geophysical surveys and surface soil, subsurface soil, leachate and ground water sampling and analysis. Figure 1-15 provides the locations of the samples taken during the Phase I RI, while Table 1-4 gives a summary of samples taken and analyses performed. It should be noted that surface soil sample locations were limited to portions of the site in which the clay/silt cap material was not present. The findings of the Phase I RI are summarized below. For a detailed assessment of the Phase I RI refer to the RI Technical Report (TRC, 1991).

1.5.3.1 Soil Assessment

Volatile organic compounds (VOCs), base neutral/acid extractable organic compounds (BNAs) (including polynuclear aromatic hydrocarbons (PAHs)), pesticides, PCBs, and inorganics were all detected in on-site soils. Appendix M of the RI Technical Report (TRC, 1991) provides hits tables for all soil samples at the site.

The major areas of the site where contaminants were detected in the soil at elevated levels include the following:

- Northern area - Carcinogenic PAHs;
- North-central area - BNAs, carcinogenic PAHs, and inorganics;
- Central landfill area - VOCs, BNAs, PCBs and inorganics;
- South of access road - BNAs, carcinogenic PAHs, and inorganics; and
- Shoreline - BNAs, carcinogenic PAHs, and inorganics.

Volatile Organic Compounds (VOCs) - 1,1,1-Trichloroethane (1,1,1-TCA) was the only VOC detected in surface soil samples (in SS-01 at 12 ppb, SS-04 at 5 ppb, and SS-06 at 2 ppb). No other VOCs were observed at detectable concentrations at any surface sampling location. In subsurface soils, VOCs detected in several samples and/or at elevated levels included 1,2-dichloroethene, 1,1,1-TCA, trichloroethene, benzene, tetrachloroethene, toluene, chlorobenzene, ethylbenzene, and xylene. In general, significant VOC contamination (i.e., greater than 1 ppm total VOCs) was detected in soils and fill in the central portion of the landfill area, but VOC levels were not consistently high throughout the depth of the soil horizons sampled. Figure 1-16 provides an illustration of the general areas of the site in which volatile organics were detected in the soil.

Base Neutral/Acid Extractables (BNAs) - The highest concentrations of total BNAs (greater than 100 ppm) were detected in four subsurface soil samples and two surface soil samples in the central and southern portions of the site (in B05-2, B09-1, M03-2, M03-3, SS-06, and SS-11 at concentrations of 1,171 ppm, 1,010 ppm, 1,943 ppm, 506 ppm, 202 ppm, and 194 ppm, respectively). The general areas in which BNAs were detected are shown in Figure 1-17. The presence and distribution of polynuclear aromatic hydrocarbons (PAHs) and carcinogenic PAHs were also considered. The highest total PAH concentrations (greater than 50 ppm) and carcinogenic PAH concentrations (22 ppm to 256 ppm) were detected in samples collected at the following locations: B-5, M-3, SS-02, SS-06, SS-08 and SS-11. Locations where total carcinogenic PAHs were elevated (greater than 1 ppm) relative to total BNA concentrations (less than 10 ppm) are also indicated in Figure 1-17.

Pesticides/PCBs - The pesticides detected most frequently in the site soils were 4,4-DDE, 4,4-DDD, and 4,4-DDT. The other pesticides detected, beta-BHC, aldrin, dieldrin, and alpha-chlordane, were each detected in only one sample. The highest pesticide concentrations were detected in surface soil sample SS-11 (4,4-DDT at 1,800 ppb) and subsurface soil sample B05-2 (4,4-DDT at 2,300 ppb).

PCBs are primarily present in the subsurface soils across the site, with nearly half (50%) of the sample locations containing detectable levels of PCBs. Four PCB Aroclors (Aroclor-1242, -1248, -1254, and -1260) were detected in at least one sample, with a maximum detected total PCB concentration of 1.1 ppm at B12-2. PCBs were detected in only four of the surface soil samples (SS-12, SS-13, SS-14, and SS-15), and all of those samples were collected from the shoreline area. Some of the highest levels (>0.2 ppm) of PCBs detected at the site were detected in soil samples collected from the 22- to 24-foot interval. Figure 1-18 shows the general areas in which of PCBs were detected in soil.

Inorganics - Inorganics levels in the site soil samples were compared to background inorganics levels, as defined by the analyses of two background surface soil samples (SS-16 and SS-17). Based on this comparison, a general trend of elevated concentrations of antimony, arsenic, barium, cadmium, calcium, chromium, cobalt, copper, lead, manganese, magnesium, nickel, silver, vanadium, and zinc across the site is apparent, as shown on Figure 1-19. Lead was particularly elevated at one surface soil sample near the shore (SS-15), where the detected concentration was 1,980 ppm.

1.5.3.2 Ground Water Assessment

For the ground water investigation, a total of nine wells were installed across the site as shown on Figure 1-15. Ground water samples were collected from all of the wells except MW-2, which was dry at the time of sampling. Three existing wells (MW-21, MW-22, and MW-23) and one leachate location (LS-1) were also sampled. Below is a summary of ground water contamination detected at the site. A detailed description can be found in the RI Technical Report (TRC, 1991). For the purpose of the RI, ground water contaminant levels were compared to federal and state action levels, including final, proposed, and tentative maximum contaminant levels (MCLs).

VOCs, BNAs, PCBs and inorganics were all detected in ground water samples. The major areas of the site where contaminants were detected at levels exceeding action levels include the following:

- Northern area - inorganics;
- North-central area - inorganics;
- Central landfill area - VOCs, and inorganics; and
- South of access road - VOCs, PCBs, and inorganics.

Ground water sample results indicated the presence of low level VOC contamination in the central and southern portions of the site, consisting mostly of aromatic VOCs (e.g., xylene and benzene). Low concentrations (1 to 160 ppb) of VOCs were detected in five of the ten on-site wells (MW-3S, MW-3D, MW-4, MW-5S, and MW-21). VOCs were also detected in soil boring samples collected at the depth of the water table from the north-central to southern portions of the site, indicating the potential for ground water contamination throughout this area. A thin oil layer was observed in one well (MW-5S) in the southern portion of the site five months after it was sampled. Figure 1-20 provides an illustration of the general extent of VOC contamination in the shallow wells.

BNAs were detected in three of the eleven wells sampled (MW-3S, MW-4, and MW-5S). The BNAs detected consisted primarily of PAHs and phenols with the highest level of total PAHs being 407 ppb at well MW-3S.

No pesticides were detected in ground water samples. A PCB concentration of 0.73 ppb was detected in the well in the southern portion of the site (MW-5S) in which a thin oil layer was subsequently observed.

The inorganic ground water sample results indicate the presence of numerous inorganic analytes in the ground water samples collected at the site. Inorganics were detected in each of the twelve wells sampled and in the leachate sample. Figure 1-21 shows the general extent of inorganic ground water contamination as defined during the Phase I RI, based on a comparison to federal action levels, as described previously.

1.5.4 **Phase II Remedial Investigations**

A Phase II RI will be conducted at McAllister Point Landfill to further characterize the site and achieve the following objectives:

- Define background soil and ground water quality;
- Further define the nature and extent of site surface soil contamination;
- Further define the nature and extent of the fill material and any associated contamination;
- Further define the nature and extent of ground water contamination and the location of "hot spot" sources of ground water contamination;
- Determine the nature and extent of sediment and biota contamination in the adjacent bay.

The investigations will include the performance of geophysical surveys to further define the extent of the landfill area and to characterize bedrock topography beneath the site, a soil gas survey to further investigate subsurface areas of elevated VOC contamination in the central and southern portions of the site, and surface and subsurface soil, ground water and leachate sampling. An off-shore investigation involving the sampling of sediments and, if present, clams and mussels, and an ecological survey of marine fauna within the bay will also be conducted.

1.6 <u>Contaminant Fate and Transport</u>

A contaminant fate and transport analysis was conducted as part of the Phase I RI to evaluate the fate and transport of contaminants associated with the site and to provide an indication of potential future contaminant movement. That analysis is summarized below. For a more detailed discussion refer to the RI Technical Report (TRC, 1991).

Several of the environmental media studied, primarily surface soils and ground water, present a potential pathway for off-site contaminant migration. Subsurface soils are not likely to be at risk of transport off-site unless exposed by excavation. Contaminants in surface soils can migrate or be carried from the site by surface runoff (resulting from precipitation), in the form of fine particulates sorbed to windblown dust, and by users of the site via vehicle tires, shoes, etc. In addition, contaminants can migrate from the surface soils through leaching (by infiltration of precipitation) and subsequent transport by ground water, and by volatilization to the ambient air. Transport of contaminants to plants through root uptake or animals by ingestion of soil or plants which may subsequently be consumed by humans represents another possible route of migration. The sampling results have demonstrated that the site ground water has been impacted, thereby indicating that contaminants have leached downward through the site soils and fill materials. As discussed in Section 1.4.2, the ground water flow direction at the site is towards Narragansett Bay, with tidal influences observed in bedrock wells located adjacent to the bay. Leachate seeps draining form the western bank of the site have also been observed. Therefore, contaminated ground water migration to Narragansett Bay is a potential migration pathway.

The discussions below are presented with respect to individual contaminants or contaminant groups. Contaminants observed in the environmental samples collected from the site include volatile organic compounds (VOCs), base neutral/acid extractable compounds (BNAs), PCBs, pesticides, and inorganics.

1.6.1 Volatile Organic Compounds

The principal mechanism for the natural removal of VOCs is through volatilization (EPA, 1979). Compounds with higher vapor pressures have a greater tendency to volatilize from soil. The role of biodegradation in the natural attenuation of these compounds is compound-specific. Similarly, the role of adsorption is compound-specific; the amount adsorbed is highly related to both the amount of organic carbon in the soil and a compound's organic/water partition coefficient (K_{oc}). The compounds with higher K_{oc} values would be preferably partitioned to organic matter in soils and thus would be less likely to be leached from the soils and transported to the ground water. However, off-site transport of these compounds could occur through the transport of particulates in surface water or through soil erosion and wind transport.

Typically, VOCs were detected infrequently and at low concentrations in on-site soils. Subsurface soils showed the greatest pattern of occurrence of VOCs of the three media sampled. VOCs detected most frequently and at the greatest concentrations in subsurface soils included ethylbenzene, tetrachloroethene, toluene, trichloroethane, and xylenes. In general, these contaminants are only moderately mobile in soils, and their presence in subsurface soils may be a result of past disposal practices.

Aromatic and chlorinated hydrocarbons present above trace concentrations (>10 ppb) in ground water samples included chlorobenzene (11 ppb), ethylbenzene (12 ppb) , and xylene (160 ppb). The chemical/physical and environmental fate data indicate that these hydrocarbons may tend to migrate downward in soils to ground water.

The ground water flow direction at the site is primarily to the west (towards Narragansett Bay). Contamination present in monitoring wells MW-21 and MW-5 is considered to be indicative of potential off-site migration of ground water contaminants. Detectable levels of xylenes were noted in monitoring wells MW-5S, MW-5D, and MW-21, suggesting potential VOC migration in the ground water.

1.6.2 Base Neutral/Acid Extractable Compounds (BNAs)

BNAs were detected in all of the media sampled on-site. BNAs are generally characterized by high boiling points, low vapor pressures, and low solubilities (except phenols).

Polynuclear aromatic hydrocarbons (PAHs), a subset of BNAs, were frequently detected in surface and subsurface soils on-site. PAHs generally have a very low solubility (<4.0 mg/l) and high K_{oc} values ($>2,500$ ml/g). This indicates that most PAHs readily adsorb to organic carbon in soils. While PAHs were detected in centrally located wells (e.g., MW-3S), PAHs were not detected in downgradient wells, such as MW-5 and MW-21. Thus, migration of PAHs from soil to ground water may have occurred in the central portion of the site but off-site migration within the ground water is not currently a primary concern.

Phenols and phenol compounds generally display a higher solubility than other BNA compounds, relatively low K_{oc}, and relatively low volatility, resulting in a tendency to leach from soil into ground water. Phenols and phenol compounds were not detected in surface soil, but were detected at a frequency of greater than 50% in subsurface soil. Phenols were detected in trace concentrations in ground water samples (2,4-dimethylphenol, 4-chloro-3-methylphenol, and 4-methylphenol). It is unclear if phenols are migrating with ground water off-site at this time since none of the contaminants detected on-site were detected in MW-21. Both 2,4-dimethylphenol and 4-chloro-3-methylphenol were detected in MW-5S but not in MW-5D.

Phthalate compounds were reported in samples from all environmental media collected at the site. They generally exhibit low solubility and high K_{oc} values, and thus would not be amenable to water transport. This statement is somewhat consistent with the site data which show that the phthalates occur at much greater concentrations in soil samples than in ground water. Phthalates detected in ground water include bis(2-ethylhexyl)phthalate, butylbenzylphthalate, dimethylphthalate, di-n-butylphthalate, di-n-octylphthalate, and diethylphthalate. Only diethylphthalate was detected in a downgradient well (MW-5D).

1.6.3 Pesticides and PCBs

Pesticide and PCB compounds were detected in both surface soil and subsurface soil samples. In general, pesticides and PCBs have an affinity for organics in soil (high K_{oc} value), which tends to render them immobile. In addition, most pesticides and PCBs tend to be persistent in the environment.

The occurrence of pesticides and PCBs at the site typically is confined to soils, with the exception of PCBs in well MW-5S in which a thin oil layer was later observed. Therefore, for the most part, pesticides and PCBs do not appear to be migrating into the ground water. Where these compounds are present in the surface soils, they have the potential to be transported with suspended sediments via surface water runoff or through wind transport of soil particles.

1.6.4 Inorganics

Many metals have an affinity for soils which reduces their mobility. The analytes which were detected at levels elevated above U.S. background surface soil levels in one or more samples are antimony, arsenic, cadmium, cobalt, copper, lead, mercury, nickel, and zinc. The analytes which appeared elevated above background in subsurface soil samples include antimony, arsenic, cadmium, cobalt, copper, lead, magnesium, mercury, nickel, selenium, and zinc. Site-specific background soil and ground water quality will be further defined during Phase II remedial investigations.

With the exception of cyanide, selenium, silver, thallium, and vanadium, all inorganic analytes were frequently detected in the ground water samples, suggesting potential migration from soils and waste fill materials. On-site inorganic levels in the ground water were compared to data from the downgradient wells (MW-5 and MW-21). Beryllium, nickel, and zinc appeared to be slightly elevated in MW-5S, indicating potential movement of these analytes in the ground water.

1.7 Human Health Assessment

A human health evaluation was conducted for the McAllister Point Landfill site on the basis of the Phase I RI. The exposure scenarios considered in the human health evaluation of the site included both current use and potential future site use scenarios, as listed:

- **Trespassing Scenario (Scenario 1)** - Exposure of trespassing children from 9 to 18 years of age to site surface soils through dermal contact and incidental ingestion.

- **Recreational Use Scenario (Scenario 2)** - Exposure of children from 6 to 18 years of age (due to development of the site as a ballfield) to site surface soils through dermal contact and incidental ingestion.

- **Construction Scenario (Scenario 3)** - Exposure of adult construction workers for a period of one year to subsurface soils through inhalation, dermal contact and incidental ingestion.

- **Commercial/Industrial Use Scenario (Scenario 4)** - Exposure of adult employees through commercial/industrial use of the site to surface soils through incidental ingestion and dermal contact and to ground water through ingestion.

- **Residential Use Scenario (Scenario 5)** - Exposure of children from 0 to 6 years of age and adults (30-year period) to surface soil through dermal contact and incidental ingestion of soil/house dust and inhalation of particulates, and to ground water through dermal contact, ingestion and inhalation of volatiles.

Human health risks potentially associated with the site, which may include risks of cancer or non-cancerous (systemic) effects, were evaluated. Both average-case (based on the geometric mean of the on-site data) and maximum (based on the highest detected on-site concentration) risks were calculated. Cancer risk levels, the lifetime incremental probabilities of excess cancer due to exposure to the site contaminants, were estimated, taking into account exposure concentrations and the carcinogenic potencies of the chemicals. The cancer risk estimates are presented in scientific notation, where a lifetime risk of 1×10^{-4} represents a lifetime risk of one in ten thousand.

Health effects associated with exposures to non-carcinogenic chemicals were evaluated using U.S. EPA Risk Reference Doses (RfDs). The associated chemical-specific risk was quantitated by the Hazard Index Ratio (HI), which is the ratio of the exposure dose to the RfD.

The calculated cancer risks and non-cancer HIs were evaluated using available regulatory guidance. The calculated risk is compared to the acceptable lifetime cancer risk range (1×10^{-4} to 1×10^{-6}) for evaluating the need for remediation, as stated in 40 CFR Part 300 (EPA, 1990b). EPA (1990b) considers a cancer risk of 1×10^{-6} as the point of departure for determining risk-based remediation goals. For non-carcinogenic risks, a target HI of unity is used (i.e., HI = 1). When the total HI for an exposed individual or group of individuals exceeds unity, there may be concern for potential non-cancer health effects. Thus, the cancer risk and HI ratios that constitute a potential concern are those which are greater than 1×10^{-4} and unity (1), respectively. Cancer risks which fall within the range of 1×10^{-4} to 1×10^{-6} (referred to as within the acceptable risk range) require further evaluation. The potential risks posed by the site in association with each scenario were evaluated, and the exposure pathway(s) driving the calculated risks are summarized below:

- **Trespassing Scenario (Scenario 1)** - Total cancer risks fall within the acceptable range; total HIs are acceptable (less than unity).

- **Recreational Use Scenario (Scenario 2)** - The maximum cancer risk value (1.3×10^{-4}), slightly exceeds the acceptable risk range. The mean risk value and total HIs are within acceptable values.

- **Construction Scenario (Scenario 3)** - The total cancer risk range and the mean HI are within acceptable values. The maximum HI (2.5) exceeded the acceptable value.

- **Commercial/Industrial Use Scenario (Scenario 4)** - The total cancer risks (1.8×10^{-3} and 3.9×10^{-3}) and the HIs (1.8 and 13) exceed acceptable values.

- **Residential Use Scenario (Scenario 5)** - The total cancer risks (ranging from 2.3×10^{-3} to 1.3×10^{-2}) and the HIs (ranging from 5 to 65) exceed acceptable values for both children and adult receptors.

For Scenarios 1, 2, and 3, the major contributing factor to the calculation of cancer risk is ingestion of carcinogenic PAHs in soil. The pathway of primary concern associated with Scenarios 4 and 5 with respect to cancer risk is ingestion of ground water containing inorganics (arsenic, beryllium) and carcinogenic PAHs. The primary contributor to the total HIs for Scenarios 1, 2, and 3 is ingestion of inorganics in soil. Ingestion of inorganics (antimony, arsenic, cadmium, chromium, copper, manganese, mercury and zinc) in ground water drives the total HIs for Scenarios 4 and 5.

While current risks posed by site surface soils to potential trespassers fall within the acceptable risk range of 1×10^{-4} to 1×10^{-6}, they exceed the point of departure risk level of 1×10^{-6}. Existing conditions at the site may pose a potential risk to the environment as well, due to the potential for contaminant migration via erosion, the continued generation of leachate as a result of the infiltration of precipitation, and ground water flow towards the bay. Additional assessment of site-related human health and environmental risks will be conducted as part of the Phase II RI.

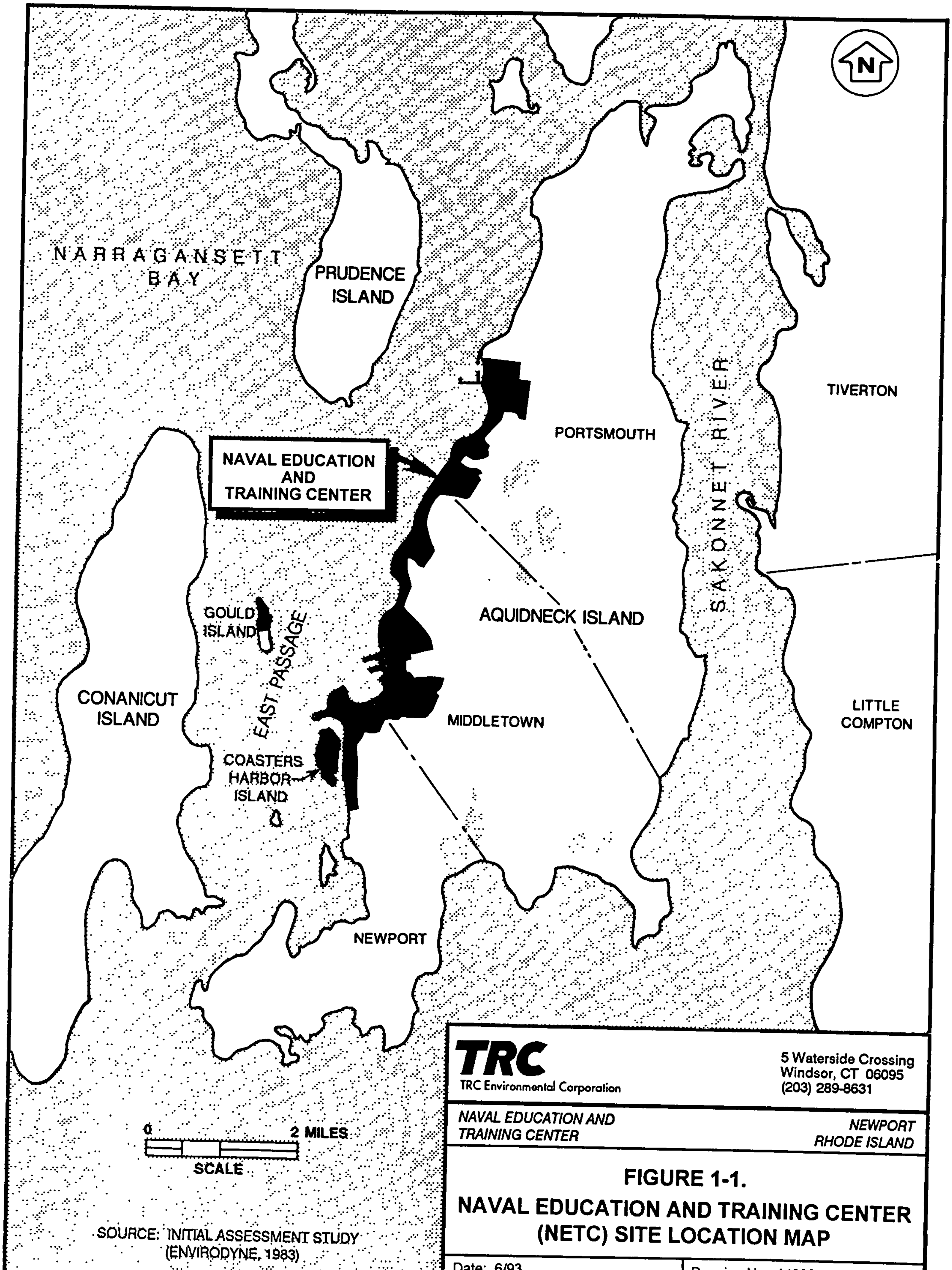

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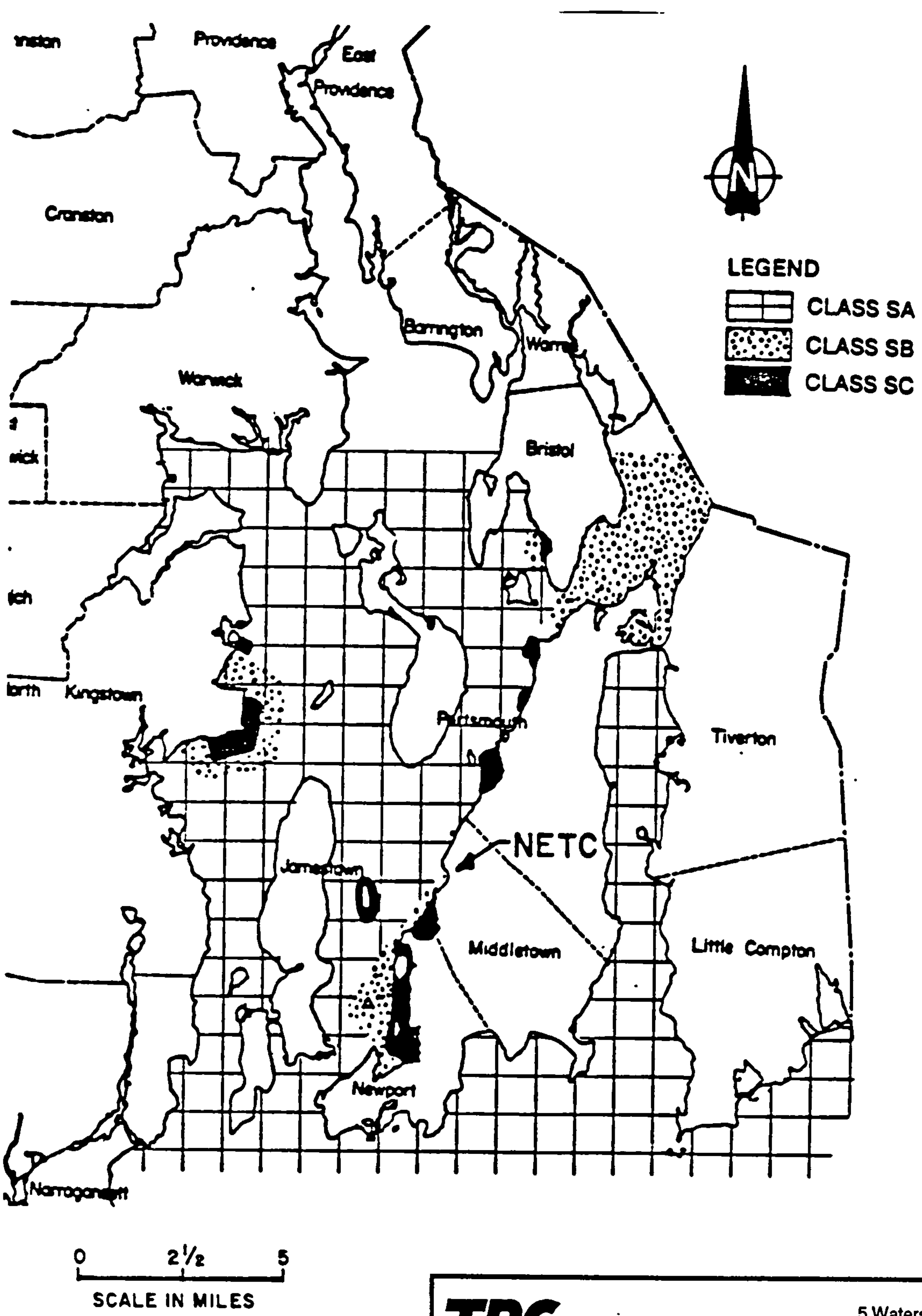
FIGURE 1-1.
NAVAL EDUCATION AND TRAINING CENTER (NETC) SITE LOCATION MAP

Date: 6/93	Drawing No 14300-N41



SOURCE: FIGURE 5.3-8 OF 1983 IAS REPORT (ENVIRODYNE)

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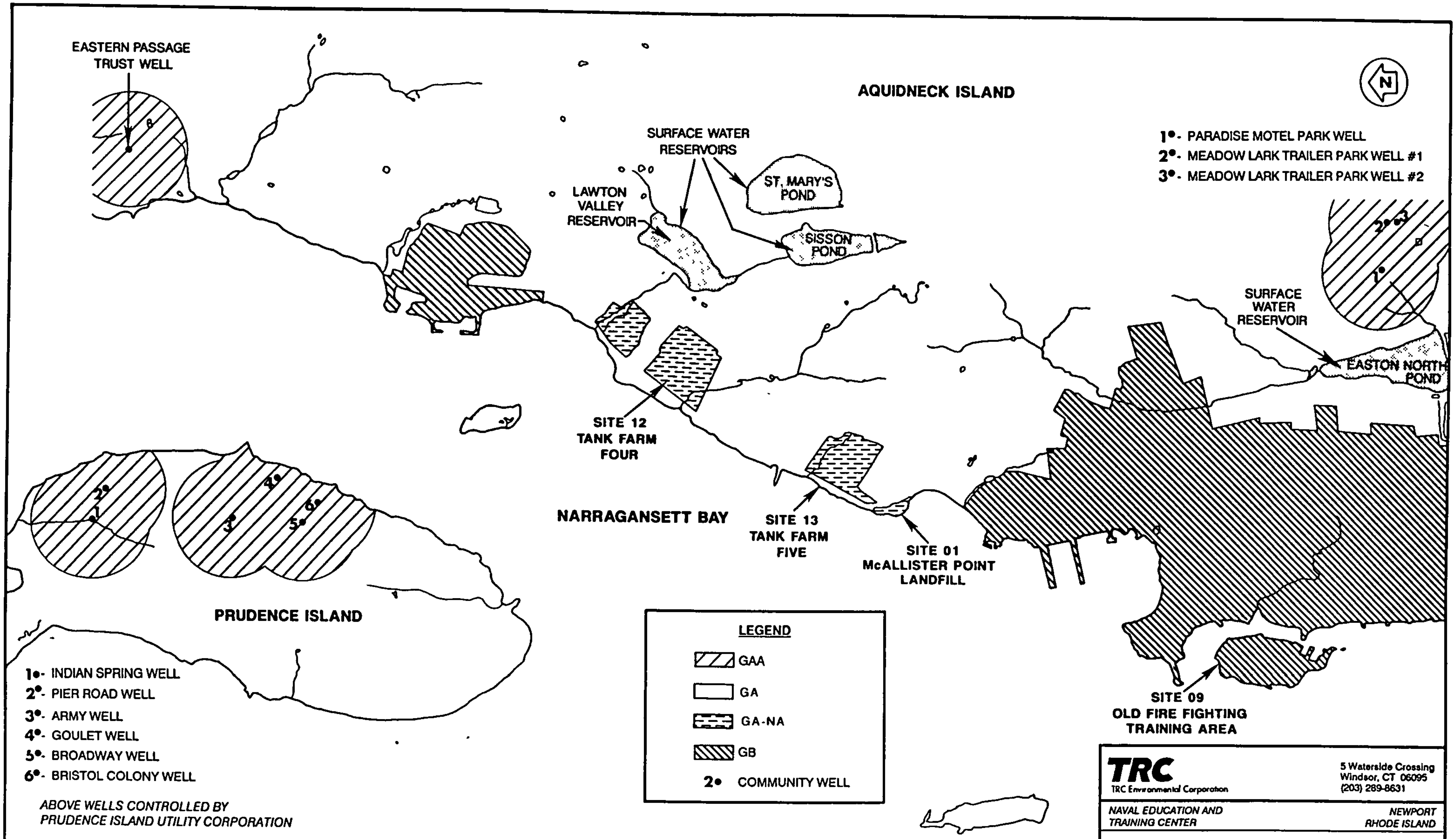
FIGURE 1-2.

SURFACE WATER QUALITY MAP OF NARRAGANSETT BAY

Date: 6/93 | Drawing No. 14300-N41



NOTES: I. SOURCE=RHODE ISLAND DEM GROUNDWATER CLASSIFICATION OVERLAY MAP PRUDENCE ISLAND QUADRANGLE

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FIGURE 1-3.
GROUND WATER CLASSIFICATION AND WATER USE MAP

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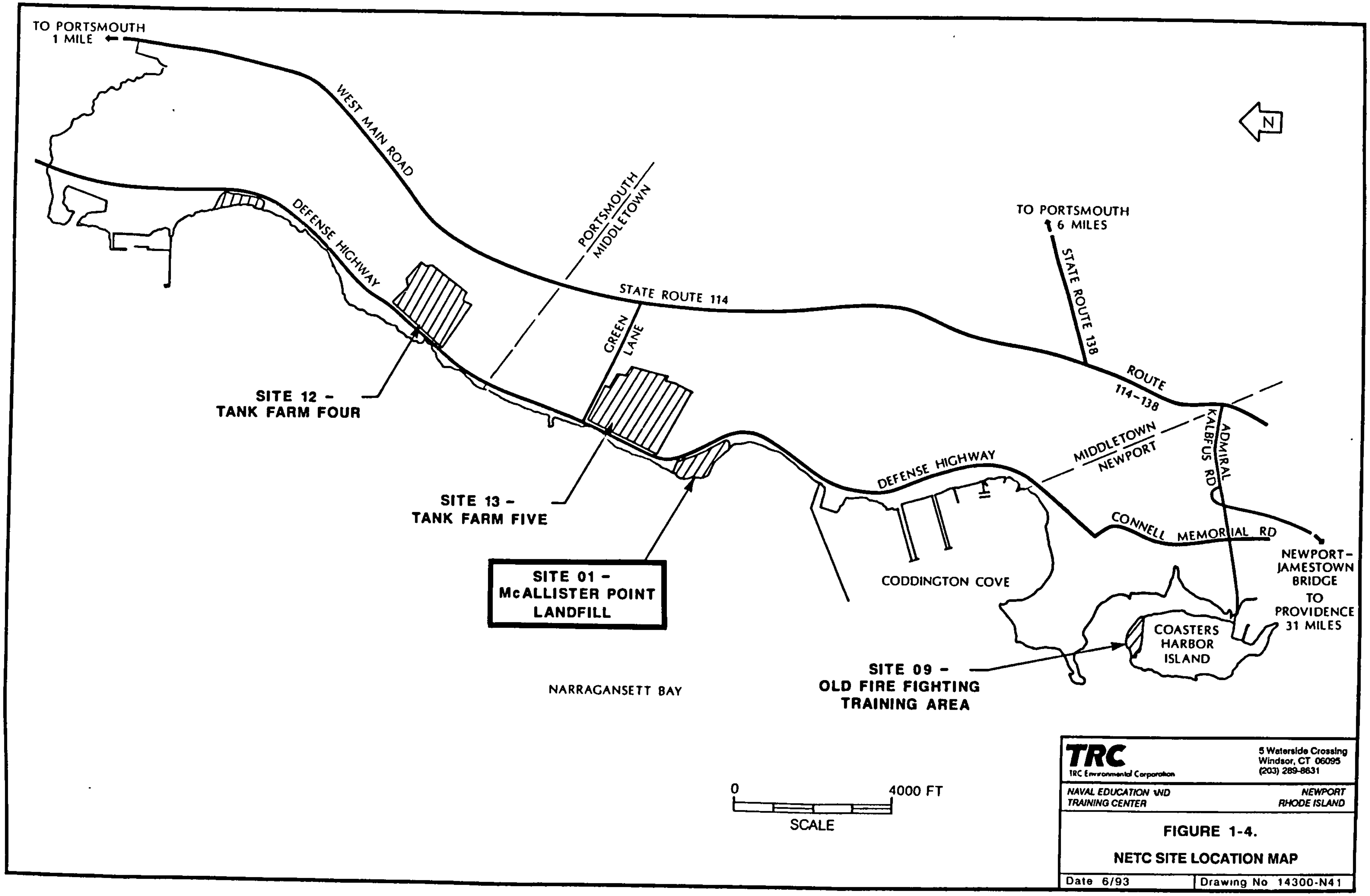

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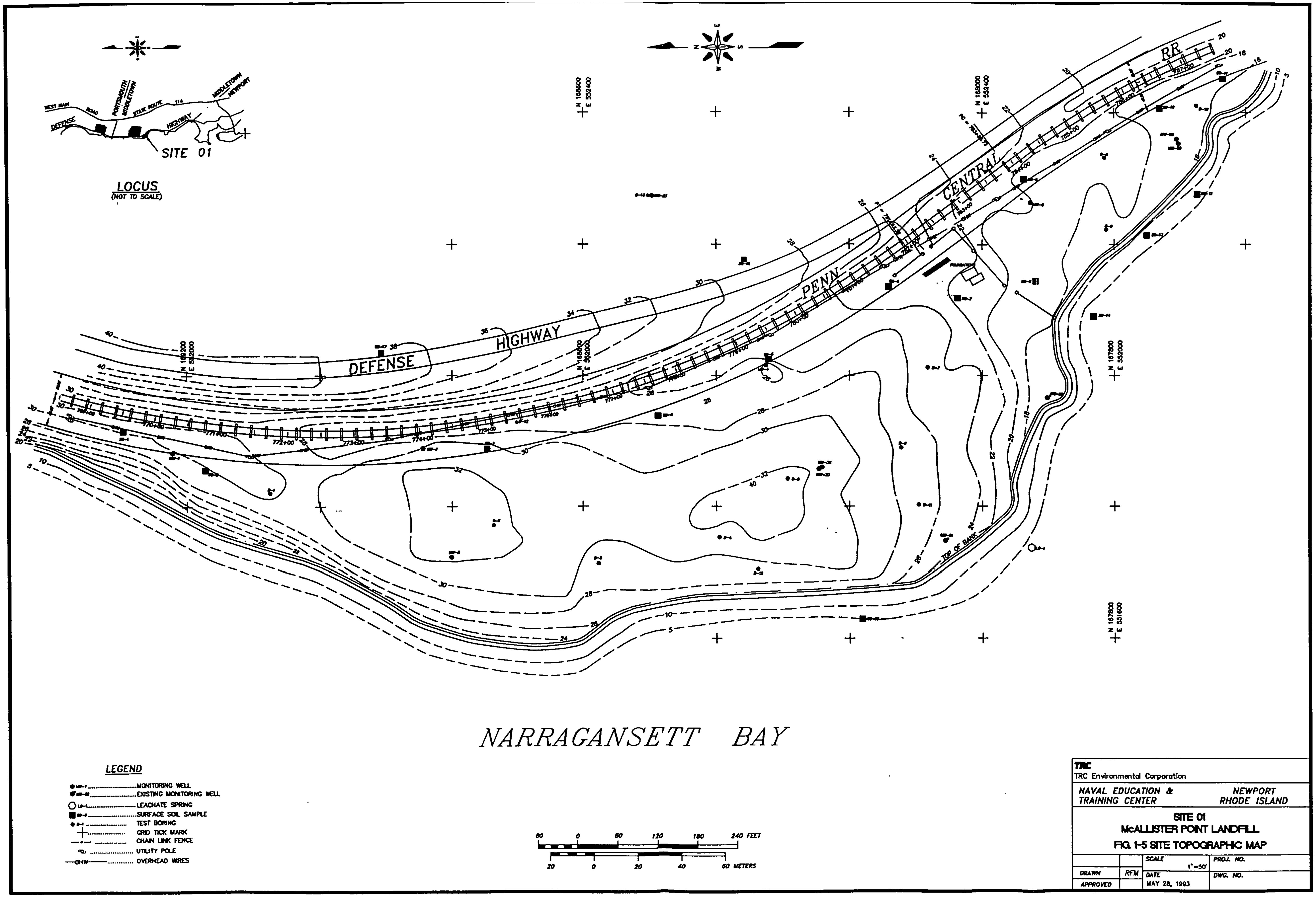
FIGURE 1-4.

NETC SITE LOCATION MAP

Date 6/93 | Drawing No 14300-N41



SITE 01
LOCUS
(NOT TO SCALE)
WEST MAIN ROAD
DEFENSE
PORTSMOUTH
MIDDLETOWN
STATE ROUTE 114
HIGHWAY
MIDDLETOWN
NEWPORT
DEFENSE HIGHWAY
PENN CENTRAL RR.
TOP OF BANK
N 168600
E 552400
N 168000
E 552400
N 168200
E 552000
N 168600
E 552000
N 167800
E 552000
N 167800
E 551600
NARRAGANSETT BAY
LEGEND
MONITORING WELL
EXISTING MONITORING WELL
LEACHATE SPRING
SURFACE SOIL SAMPLE
TEST BORING
GRID TICK MARK
CHAIN LINK FENCE
UTILITY POLE
OVERHEAD WIRES
60 0 60 120 180 240 FEET
20 0 20 40 60 METERS
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NEWPORT RHODE ISLAND
SITE 01
McALLISTER POINT LANDFILL
FIG. 1-5 SITE TOPOGRAPHIC MAP
SCALE 1"=50'
PROJ. NO.
DRAWN RFM
DATE MAY 28, 1993
DWG. NO.
APPROVED

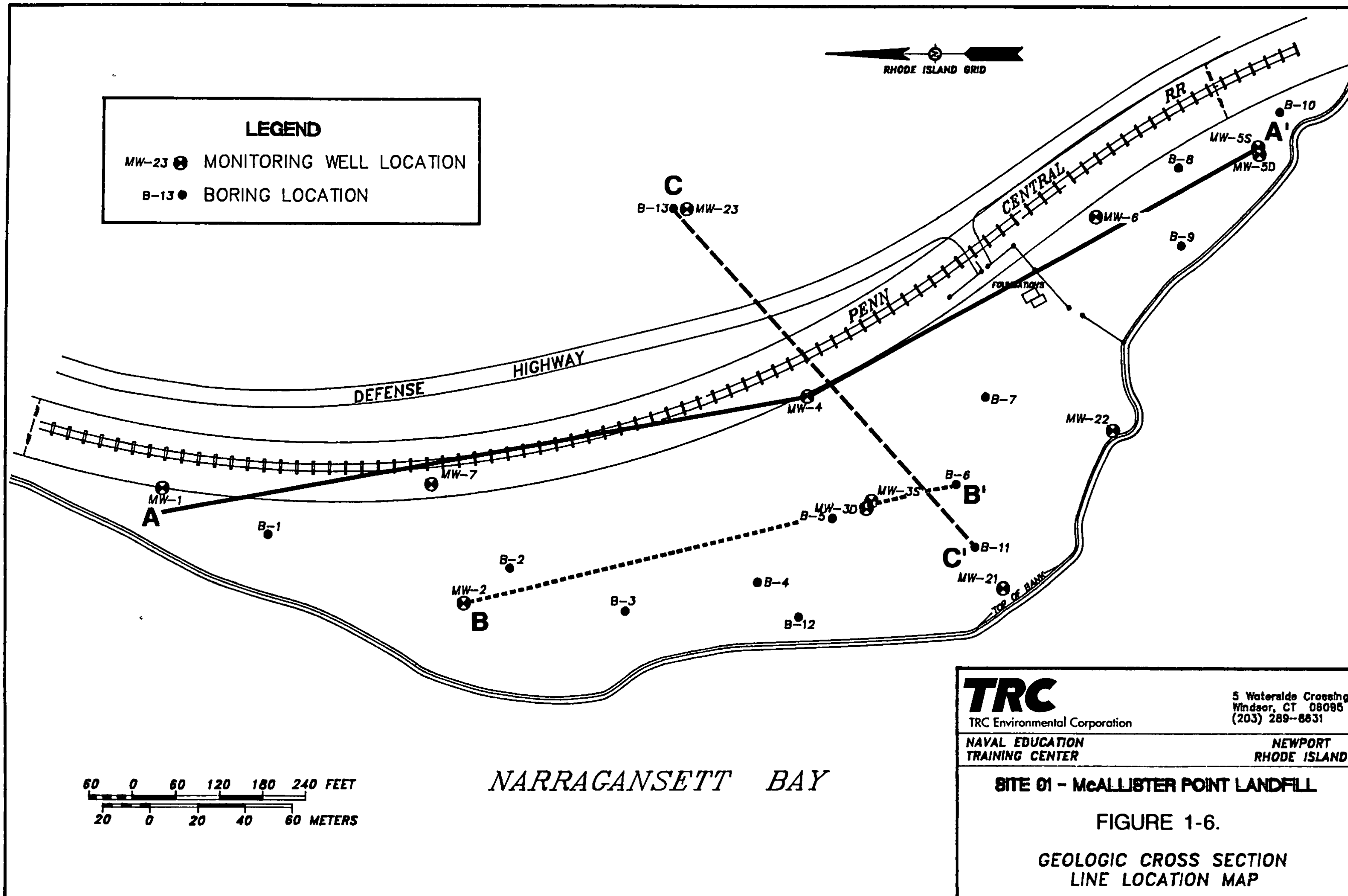

FIGURE 1-6.

GEOLOGIC CROSS SECTION
LINE LOCATION MAP

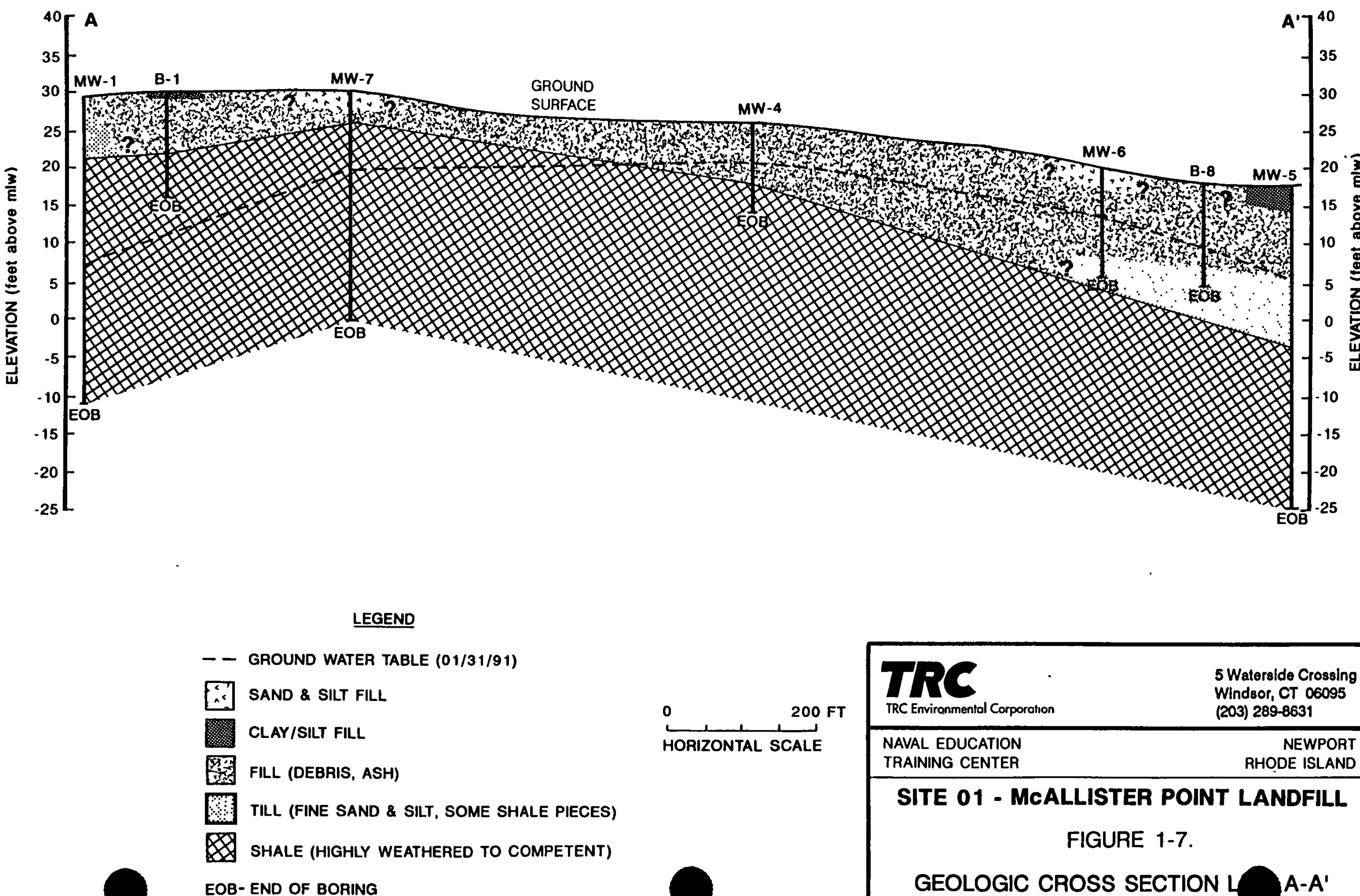

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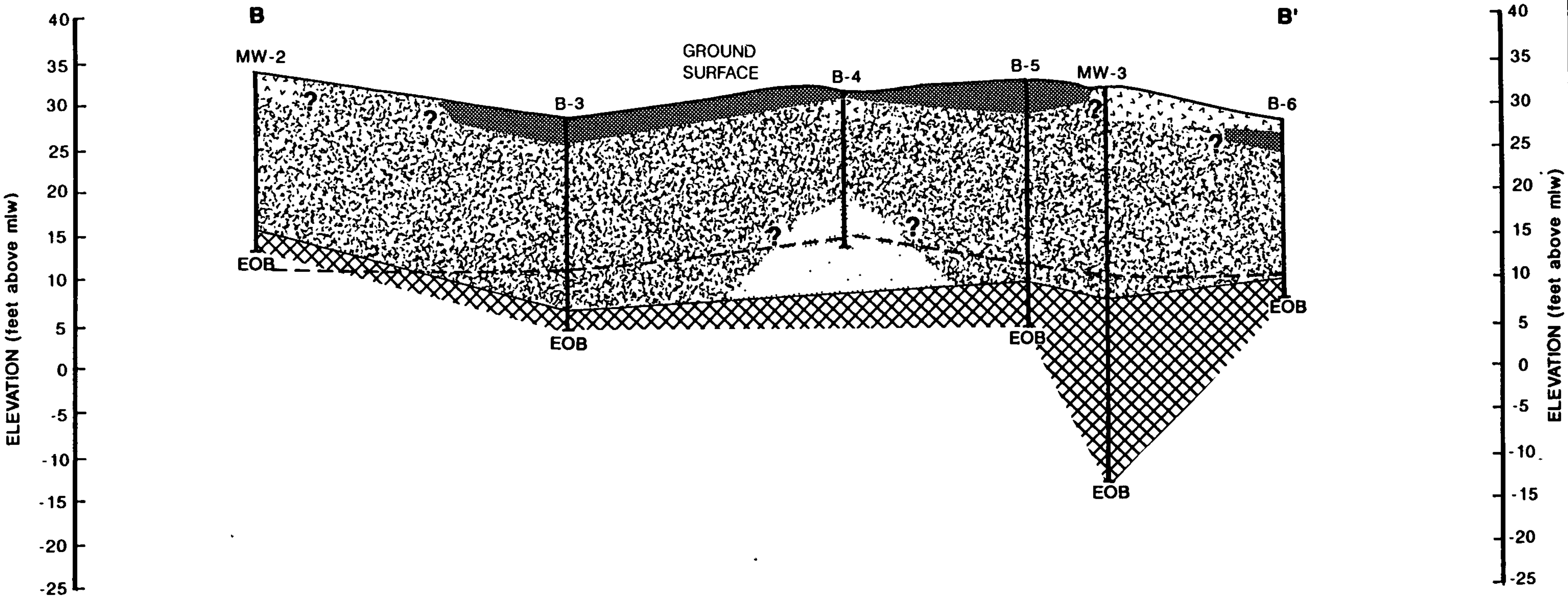
FIGURE 1-7.

GEOLOGIC CROSS SECTION L[illegible] A-A'



NOTE WATER TABLE DEPTH AT BORINGS EXTRAPOLATED FROM GROUND WATER CONTOUR MAP

LEGEND

— — GROUND WATER TABLE (01/31/91)

SAND & SILT FILL

CLAY/SILT FILL

FILL (DEBRIS, ASH)

TILL (FINE SAND & SILT, SOME SHALE PIECES)

SHALE (HIGHLY WEATHERED TO COMPETENT)

EOB- END OF BORING

0 120 FT
HORIZONTAL SCALE

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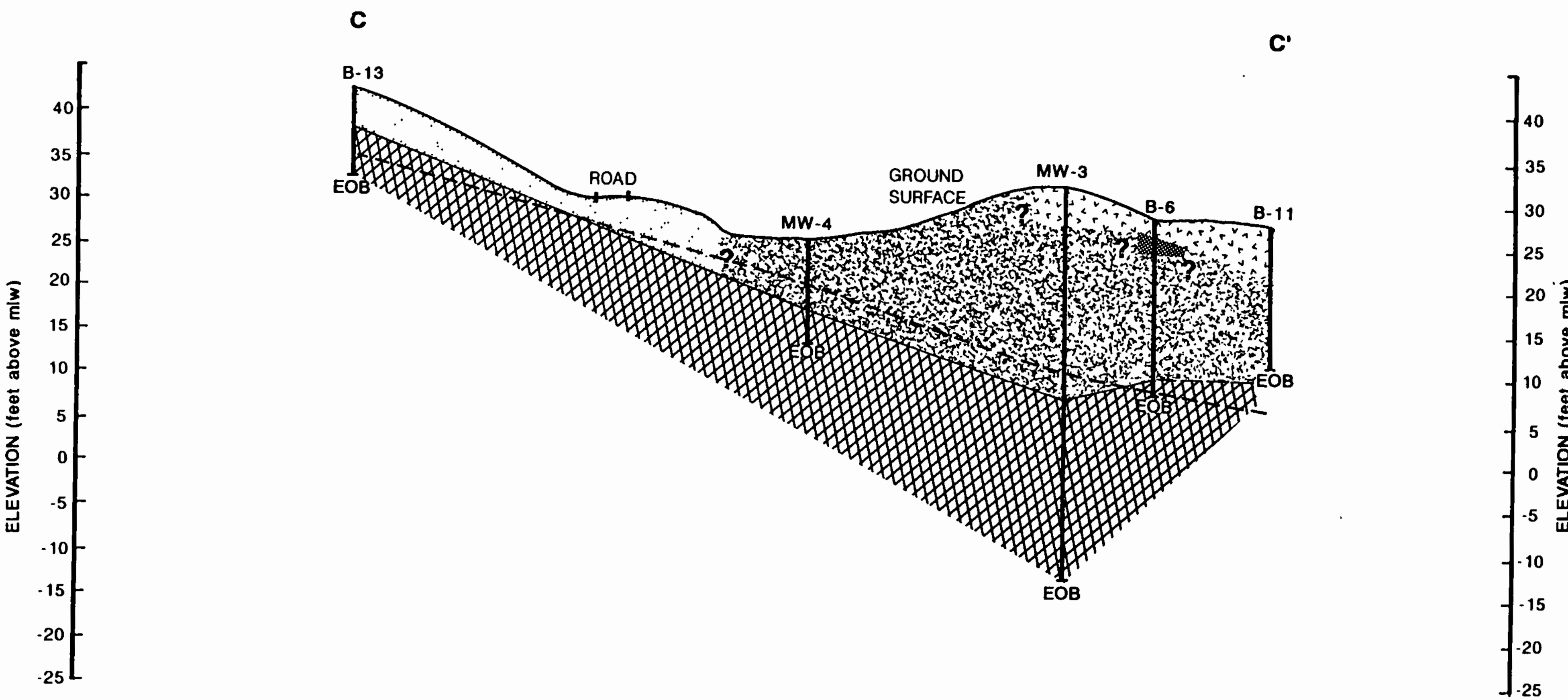
FIGURE 1-8.

GEOLOGIC CROSS SECTION LINE B-B'



NOTE: WATER TABLE DEPTH AT BORINGS EXTRAPOLATED FROM GROUND WATER CONTOUR MAP

LEGEND

— — GROUND WATER TABLE (01/31/91)

SAND & SILT FILL

CLAY/SILT FILL

FILL (DEBRIS, ASH)

TILL (FINE SAND & SILT, SOME SHALE PIECES)

SHALE (HIGHLY WEATHERED TO COMPETENT)

EOB- END OF BORING

0 120 FT

HORIZONTAL SCALE

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FIGURE 1-9.

GEOLOGIC CROSS SECTION LI[illegible]C-C'

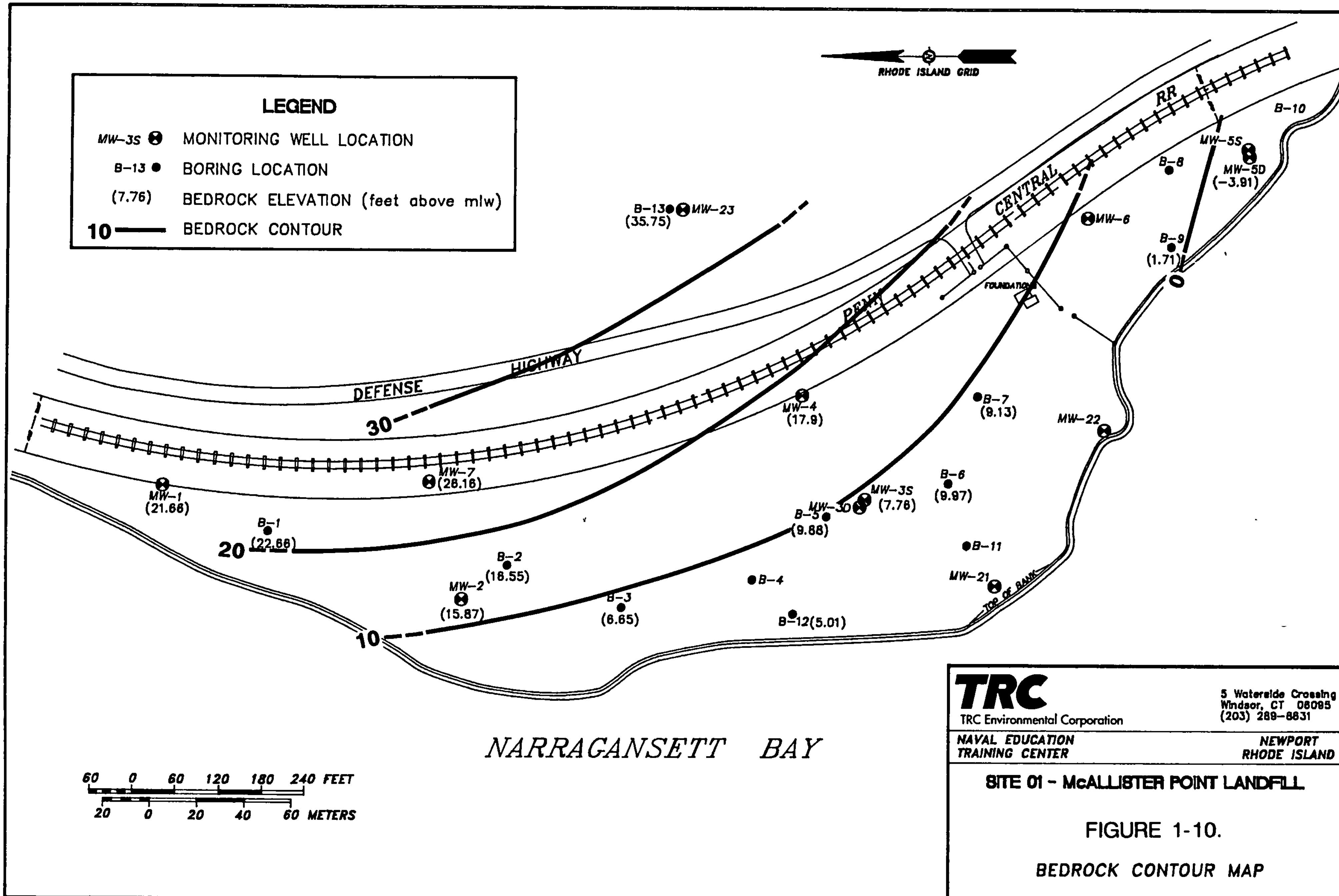

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FIGURE 1-10.

BEDROCK CONTOUR MAP

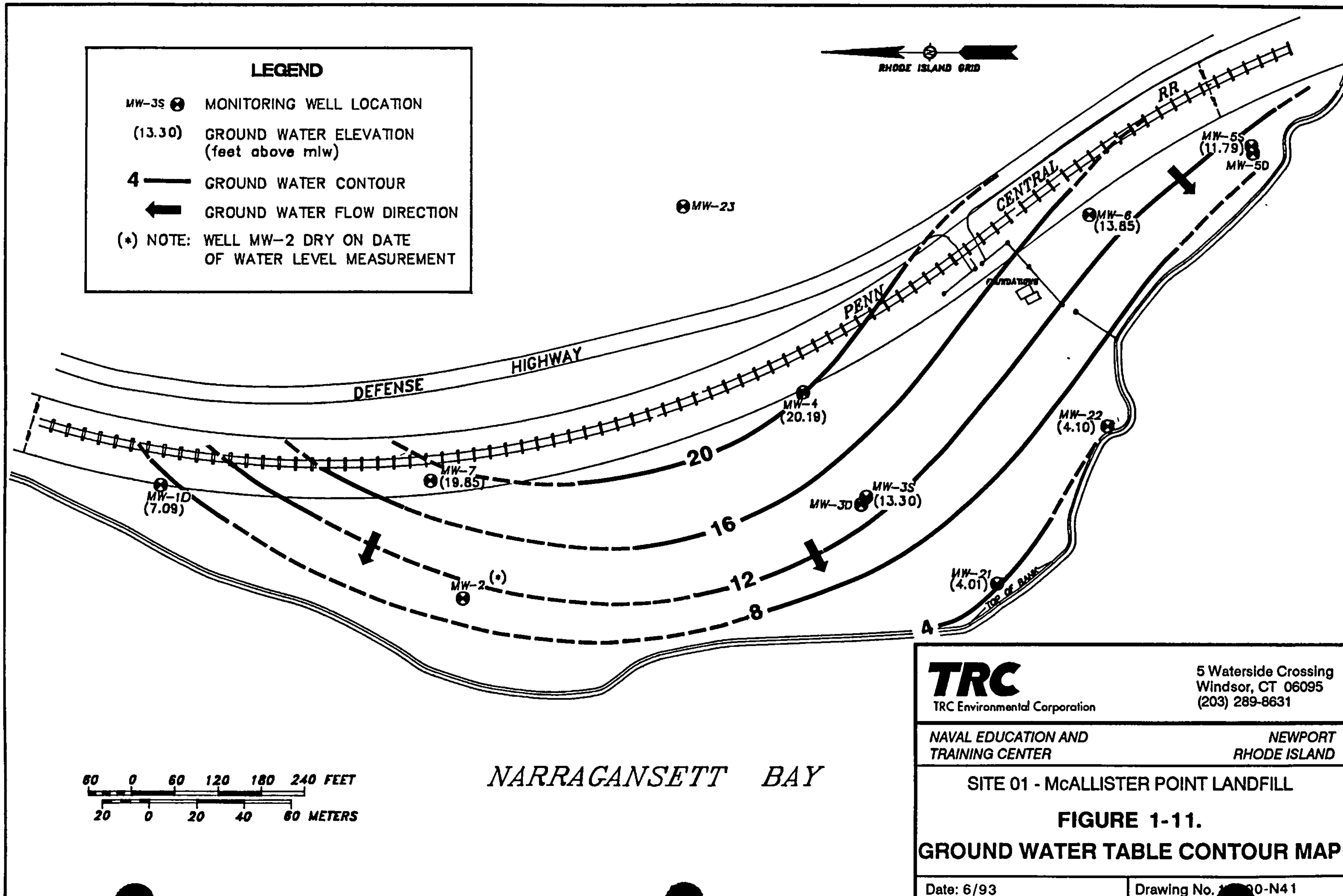

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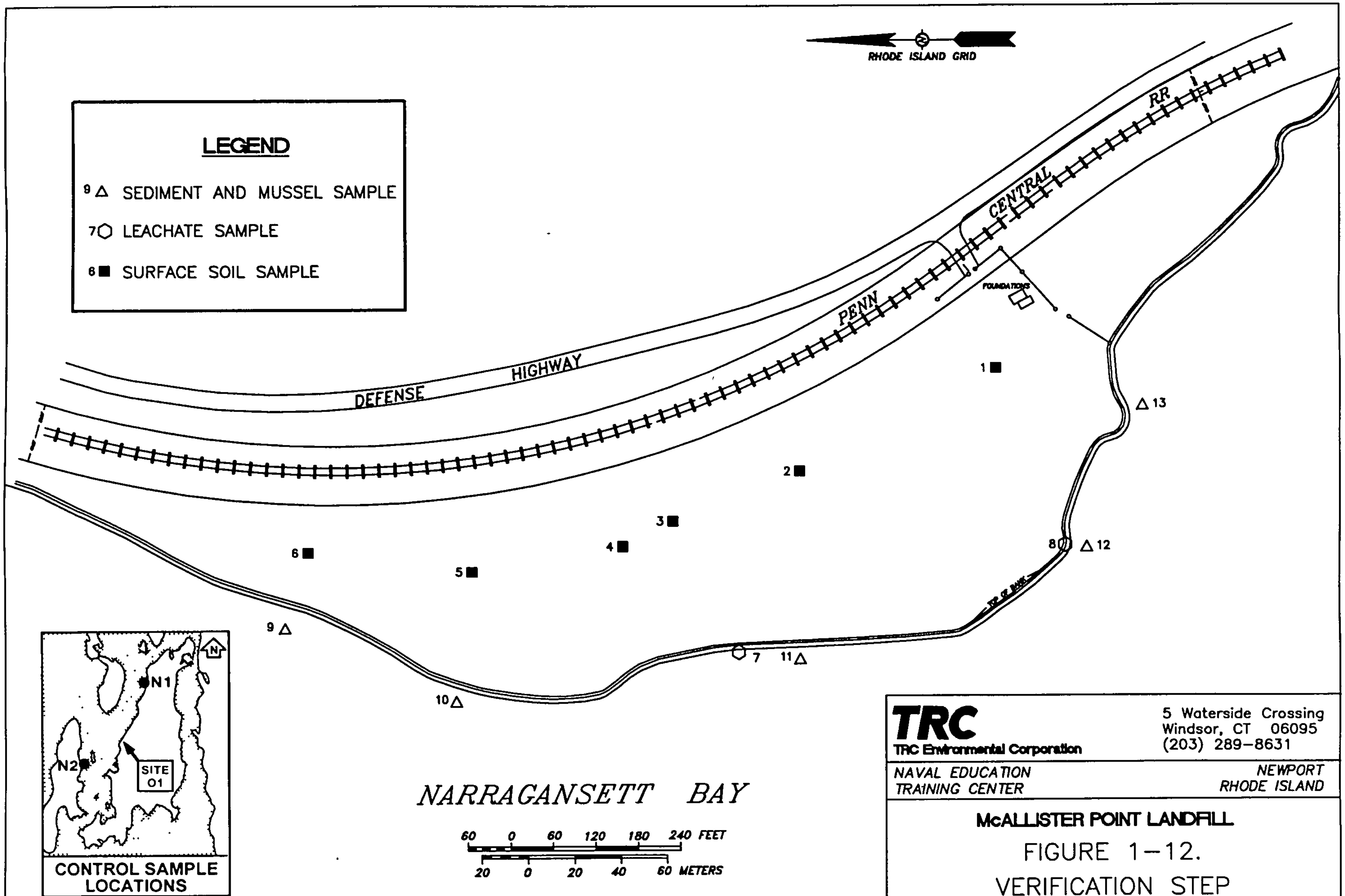
FIGURE 1-11.
GROUND WATER TABLE CONTOUR MAP

Date: 6/93 | Drawing No. 1[illegible]0-N41



NOTE: CONTROL SAMPLES OF SEDIMENTS AND MUSSELS WERE ALSO COLLECTED AT TWO OFF-SITE POINTS (N1 AND N2) WITHIN NARRAGANSETT BAY (SEE INSET)

SOURCE: CONFIRMATION STUDY REPORT (LOUREIRO, 1986)

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FIGURE 1-12.

VERIFICATION STEP SAMPLING LOCATIONS

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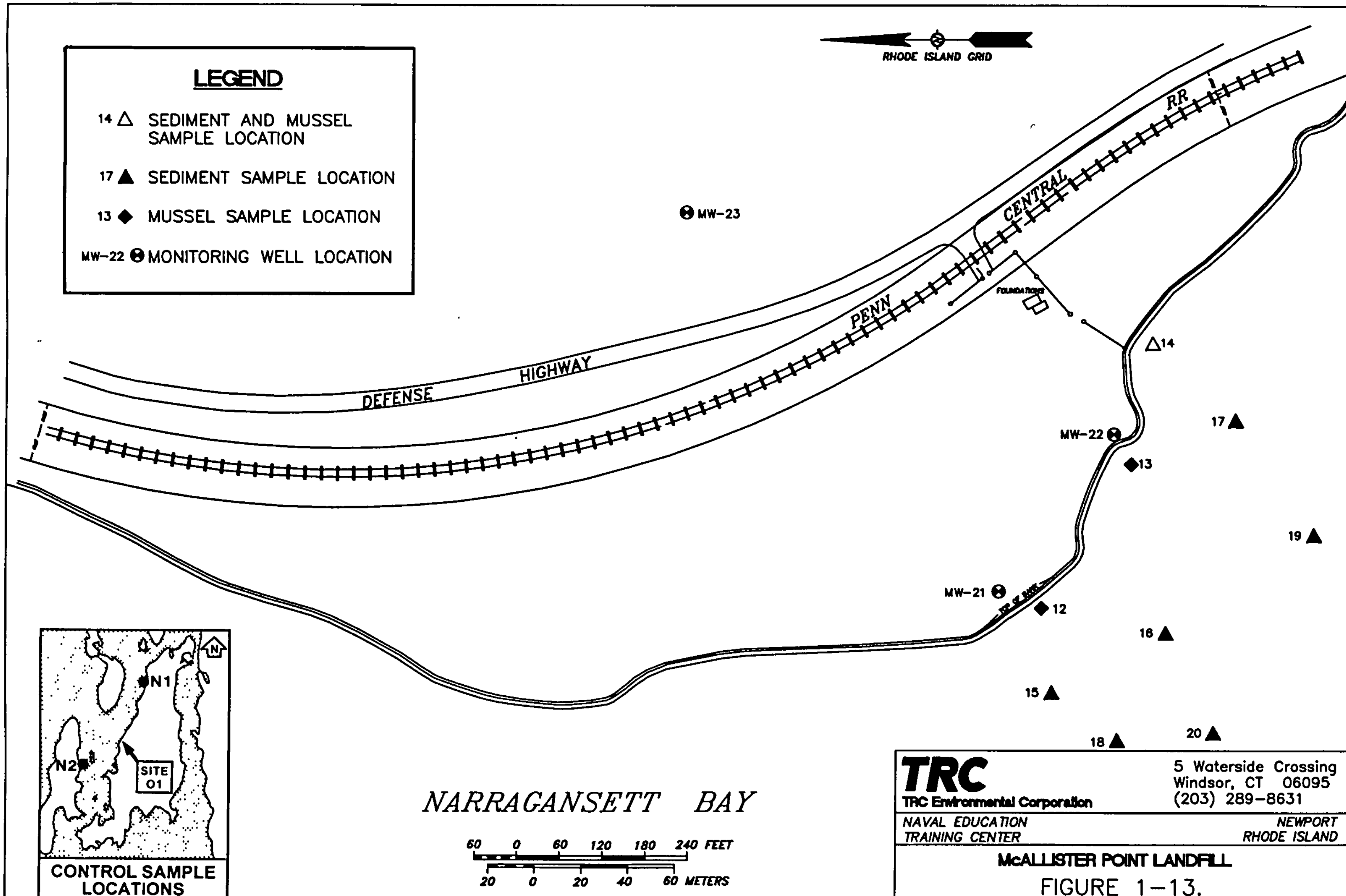

NOTE: CONTROL SAMPLES OF MUSSELS WERE ALSO COLLECTED AT TWO OFF-SITE POINTS (N1 AND N2) WITHIN NARRAGANSETT BAY (SEE INSET)

SOURCE: CONFIRMATION STUDY REPORT (LOUREIRO, 1986)

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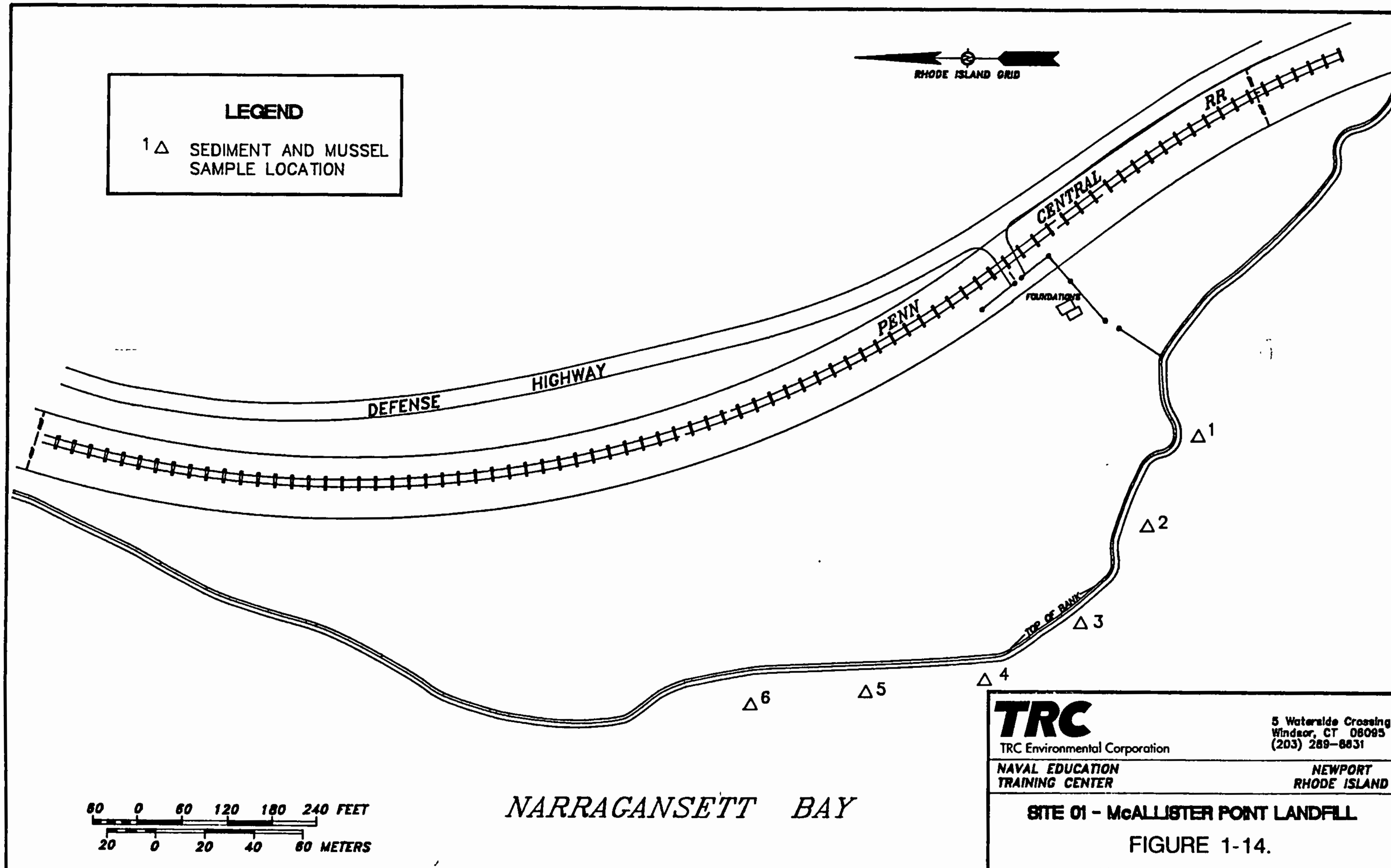
McALLISTER POINT LANDFILL

FIGURE 1-13.
CHARACTERIZATION STEP SAMPLING LOCATIONS

Date: 7/93 | Drawing No. 1 -N41



SOURCE: REPORT ON GOULD ISLAND, McALLISTER POINT, AND ALLEN HARBOR SEDIMENT AND MUSSEL SAMPLING (U.S. ACE, 1988).

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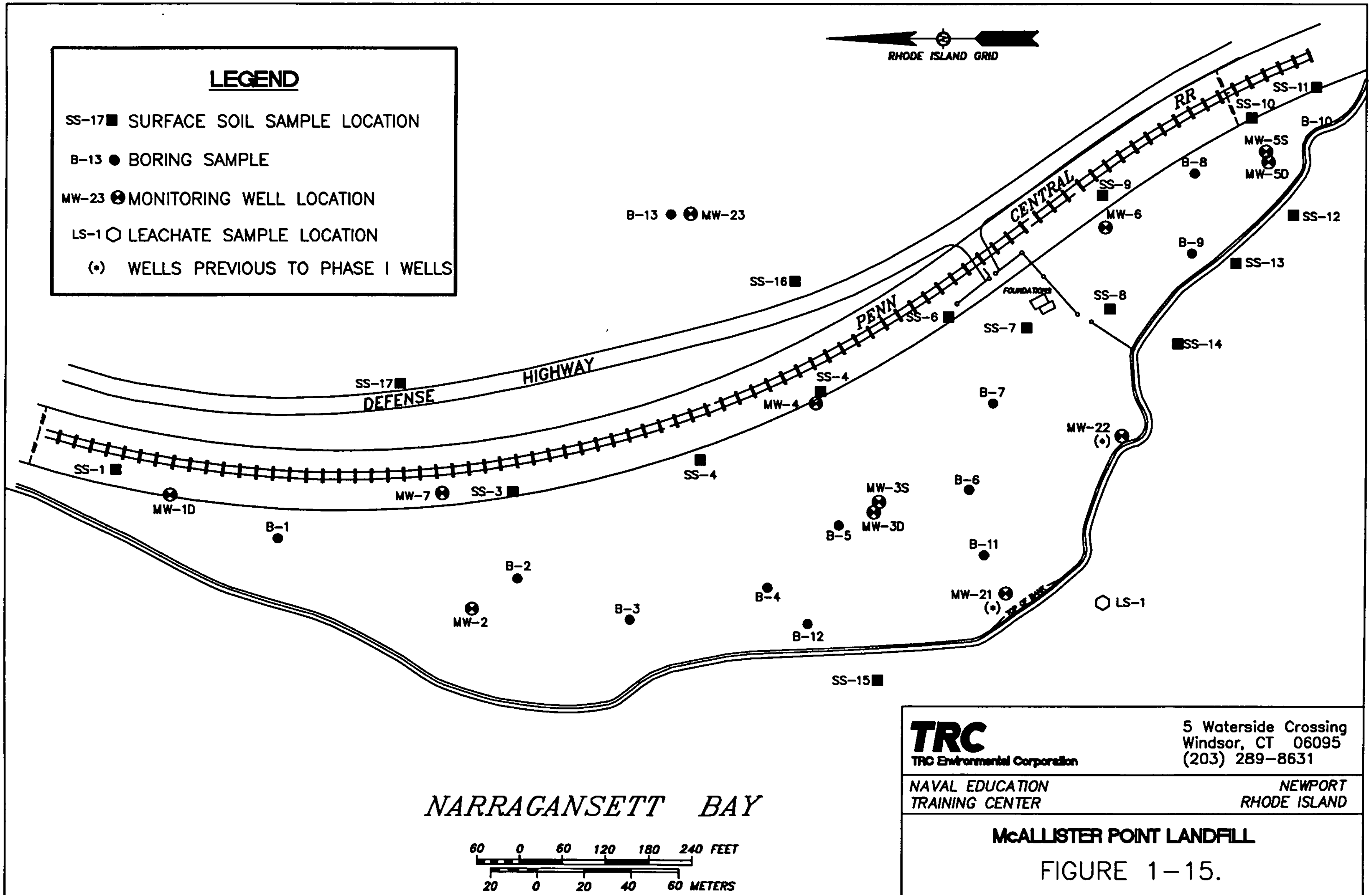
FIGURE 1-14.

ARMY CORPS OF ENGINEERS SEDIMENT AND MUSSEL SAMPLING LOCATIONS



NOTE: SURFACE SOIL SAMPLES SS-12, SS-13, SS-14 AND SS-15 WERE COLLECTED ALONG THE SHORELINE OF THE SITE. LEACHATE SEEP SAMPLE LS-1 WAS COLLECTED FROM THE SEAWARD EMBANKMENT OF THE SITE.

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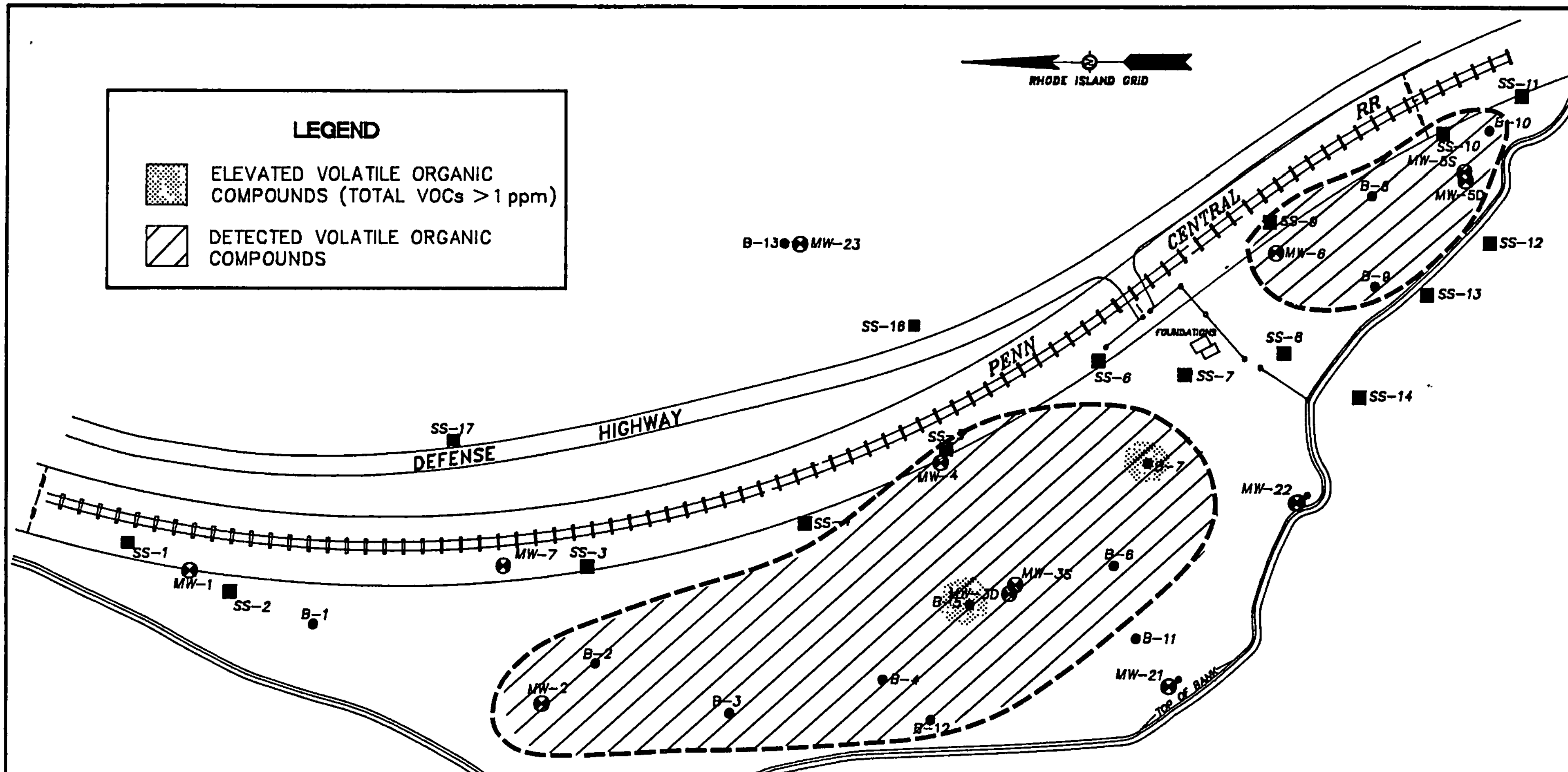
McALLISTER POINT LANDFILL

FIGURE 1-15.

PHASE I
INVESTIGATION SUMMARY

Date: 7/93	Drawing No. [illegible]0-N41



NOTE: LOW LEVEL VOCS DETECTED IN REANALYSIS OF SURFACE SOIL SAMPLES SS-01, SS-04 AND SS-06

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FIGURE 1-16.

EXTENT OF VOLATILE ORGANIC SOIL CONTAMINATION

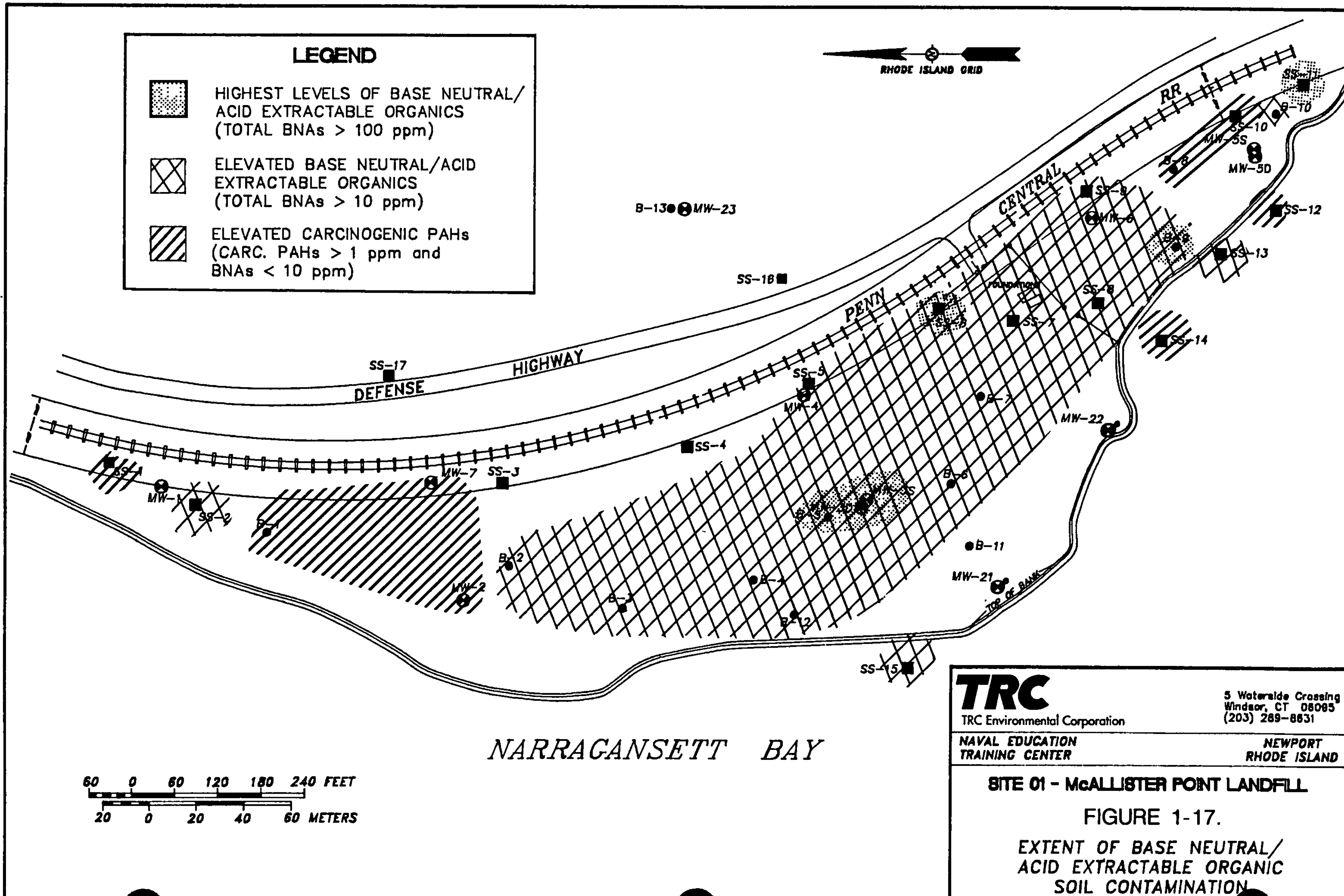

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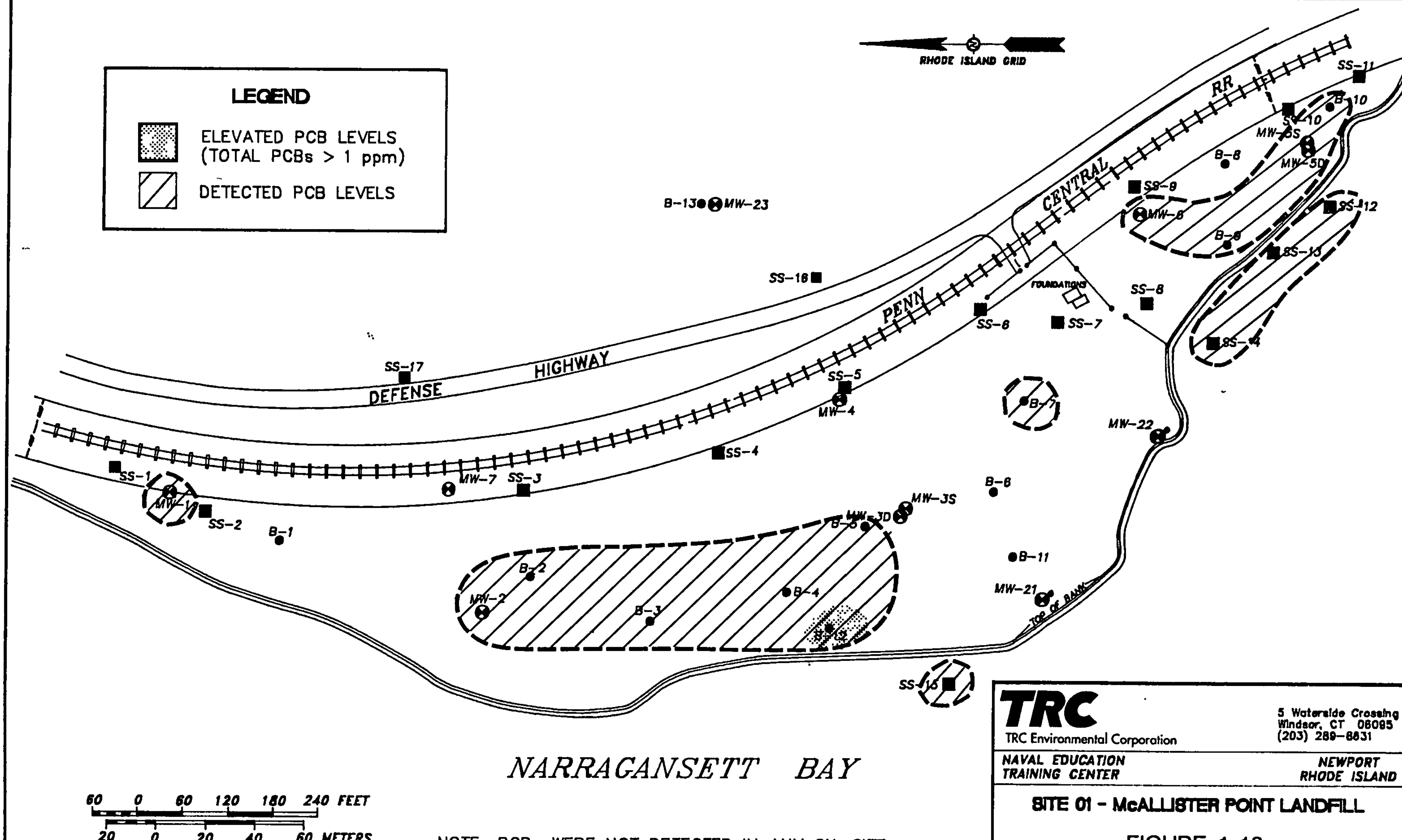
FIGURE 1-17.

EXTENT OF BASE NEUTRAL/ ACID EXTRACTABLE ORGANIC SOIL CONTAMINATION



NOTE: PCBs WERE NOT DETECTED IN ANY ON-SITE SURFACE SOIL SAMPLES; ONLY IN THE SHORELINE SURFACE SOIL SAMPIES.

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FIGURE 1-18.

EXTENT OF PCB SOIL CONTAMINATION

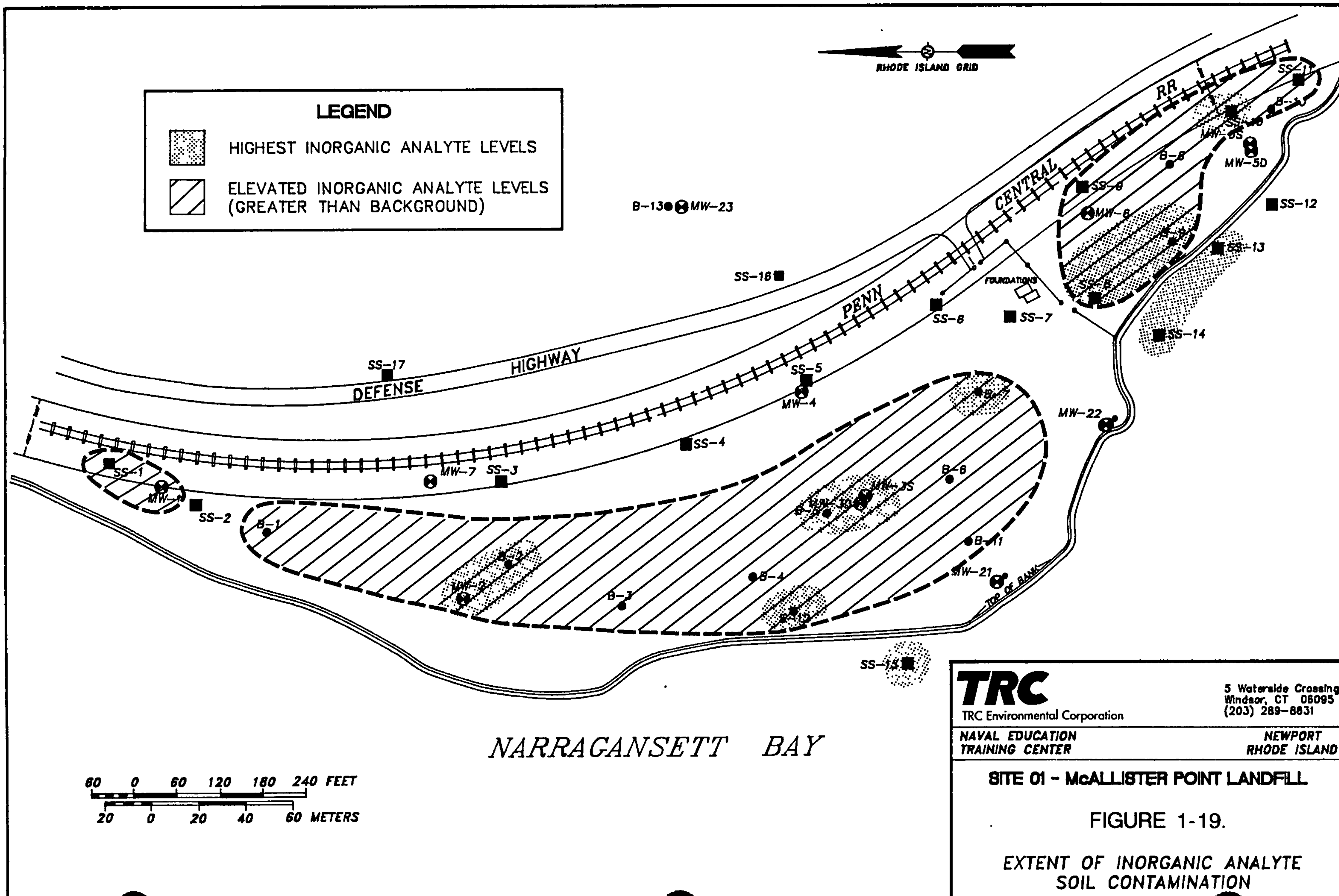

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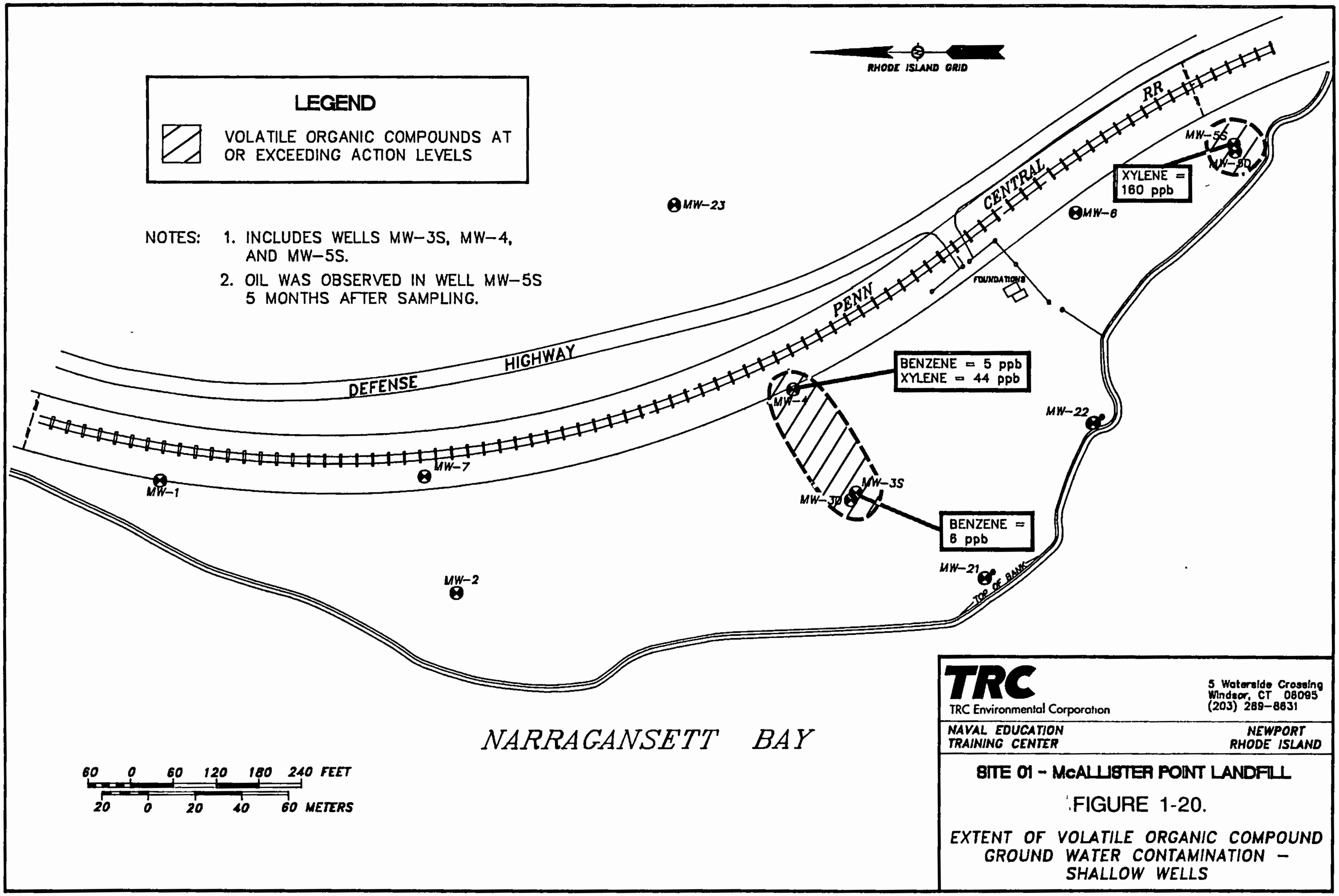
FIGURE 1-19.

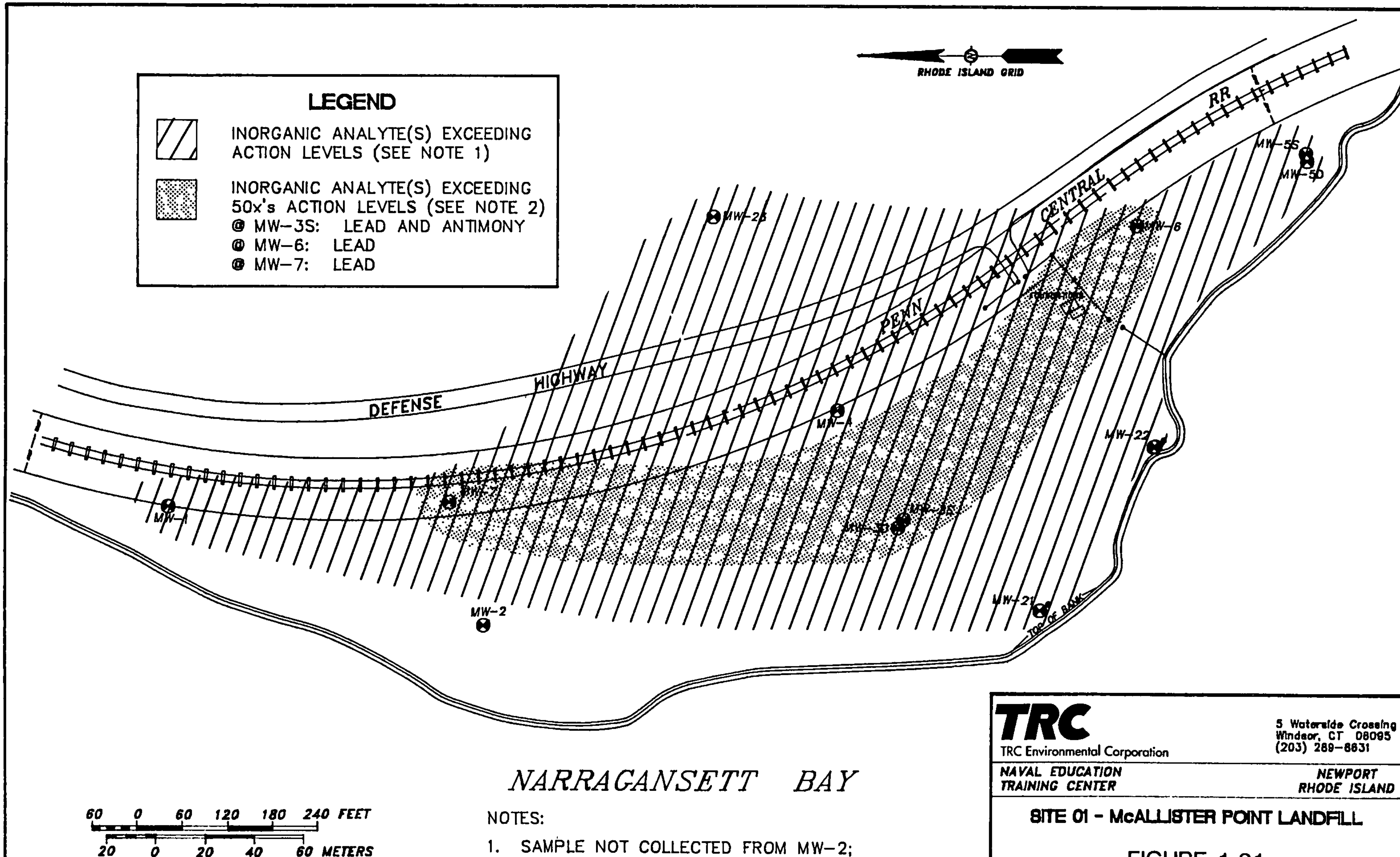
EXTENT OF INORGANIC ANALYTE SOIL CONTAMINATION



SITE 01 - McALLISTER POINT LANDFILL

FIGURE 1-20.

EXTENT OF VOLATILE ORGANIC COMPOUND GROUND WATER CONTAMINATION - SHALLOW WELLS



NOTES:

1. SAMPLE NOT COLLECTED FROM MW-2; DRY ON SAMPLING DATE.
2. ALUMINUM, IRON AND MANGANESE ALSO EXCEEDING 50x's ACTION LEVELS IN MOST WELLS.

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SITE 01 - McALLISTER POINT LANDFILL

FIGURE 1-21.

EXTENT OF INORGANIC ANALYTE GROUND WATER CONTAMINATION

TABLE 1-1

PHASE I REMEDIAL INVESTIGATION SAMPLE SUMMARY
FOCUSED FEASIBILITY STUDY
SITE 01 - McALLISTER POINT LANDFILL
NETC - NEWPORT, RI

MATRIX (SAMPLE TYPE)	NUMBER OF SAMPLES ENVIRONMENTAL	DUPLICATE	FIELD BLANK	TRIP BLANK(1)	EPA SPLIT	ANALYSES(2)
SURFACE SOIL	15	2	-	3	-	A,B,C,D,E
	-	-	3		-	A,B,C,D
	4	1	1	1	-	A
	2	-	-	-	-	D
TEST BORINGS	26	3	-	-	-	A,B,C,D,E
	4	-	6	8	-	A,B,C,D
	1	-	-	-	-	A,D,E
	2	-	-	-	-	F
WELL BORINGS	10	-	-	-	-	A,B,C,D,E
	8	1	5	5	-	A,B,C,D
GROUND WATER	11	1	1	4	2	A,B,C,D
TAP WATER (3)	2	-	-	-	-	A,B,C,D
LEACHATE SPRING WATER	1	-	-	1	-	A,B,C,D

(1) - Trip blanks analyzed for volatile organic compounds only.
(2) - Analyses performed as follows:
A) Target Compound List Volatile Organic Compounds
B) Target Compound List Base Neutral/Acid Extractable Compounds
C) Target Compound List Pesticide/PCB Compounds
D) Target Analyte List (Metals & Cyanide)
E) 2,3,7,8-TCDD (Dioxin) Archived
F) TCLP Analysis
(3) - Samples of Tap Water Used In Equipment Decontamination.

TABLE 1-1
VERIFICATION STEP SAMPLE ANALYSIS SUMMARY
FOCUSED FEASIBILITY STUDY
SITE 01 - McALLISTER POINT LANDFILL
NETC - NEWPORT, RI

	SEDIMENTS (µg/g)		MUSSELS (µg/g)		SOIL COMP. (µg/g)		LEACHATE (mg/l)	
	MAX.	AVG.	MAX.	AVG.	MAX.	AVG.	MAX.	AVG.
PARAMETER								
VOLATILE ORGANICS	NA	NA	NA	NA				
Ethylbenzene					ND	ND	0.030	0.017
Toluene					ND	ND	0.026	0.015
BNAs	NA	NA	NA	NA	ND	ND	ND	ND
PESTICIDES	NA	NA	NA	NA	ND	ND	ND	ND
PCBs	ND	ND	0.38	0.29	ND	ND	ND	ND
INORGANICS								
Cadmium	ND	ND	ND	ND	ND	ND	0.058	0.047
Chromium	17.5	10.4	ND	ND	7.3	7.3	0.032	0.027
Copper	1455	350.5	28.3	10.5	13.5	13.5	ND	ND
Lead	900	209.5	ND	ND	9.0	9.0	ND	ND
Nickel	64.0	32.3	ND	ND	20.5	20.5	ND	ND
Zinc	NA	NA	NA	NA	0.3	0.3	ND	ND
Cyanides	NA	NA	NA	NA	0.047	0.047	0.876	0.330
Phenols	NA	NA	NA	NA	0.027	0.027	0.016	0.010
Chlorides	NA	NA	NA	NA	NA	NA	15.5	14.8

NA = Not analyzed
ND = Not detected
Note: In calculating average concentration, non-detected constituents were conservatively assumed to be present at a concentration equal to the detection limit.

TABLE 1-2
CHARACTERIZATION STEP SAMPLE ANALYSIS SUMMARY
FOCUSED FEASIBILITY STUDY
SITE 01 - McALLISTER POINT LANDFILL
NETC - NEWPORT, RI

	SEDIMENTS (μg/gm)		MUSSELS (μg/gm)		GROUND WATER UPGRADIENT (mg/l)		GROUND WATER DOWNGRADIENT (mg/l)	
	MAX.	AVG.	MAX.	AVG.	MAX.	AVG.	MAX.	AVG.
PARAMETER								
VOLATILE ORGANICS	NA	NA	NA	NA	ND	ND	ND	ND
BNAs	NA	NA	NA	NA				
Butyl benzyl phthalate					0.366	0.366	ND	ND
Bis (2-ethyl hexyl) phthalate					0.931	0.931	0.064	0.041
Di-n-octyl phthalate					0.553	0.553	0.062	0.041
PESTICIDES	NA	NA	NA	NA	ND	ND	ND	ND
PCBs	NA	NA	NA	NA	ND	ND	ND	ND
INORGANICS								
Chromium (Total)	22.0	14.6	3.5	1.87	0.09	0.044	0.17	0.08
Copper (Total)	890	137.5	20.6	10.7	0.11	0.062	1.04	0.454
Cyanide (Total)	ND	ND	NA	NA	0.009	0.0058	0.013	0.0075
Lead (Total)	267	67.8	19.9	10.2	0.10	0.06	1.58	0.554
Nickel (Total)	86.6	24.8	6.6	4.98	0.19	0.084	0.30	0.118
Nickel (EP Tox. mg/l)	0.71	0.36	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	82	82	0.500	0.350
pH	NA	NA	NA	NA	6.18	5.96	7.01	6.66
Chlorine	NA	NA	NA	NA	3.8	2.95	795	240.5
Phenols	NA	NA	NA	NA	7	7	21	17

NA = Not analyzed
ND = Not detected
Notes: 1) In calculating average concentration, non-detected constituents were conservatively assumed to be present at a concentration equal to the detection limit.
2) Upgradient well is Station 23; downgradient wells are Stations 21 and 22.

TABLE 1-3
RANGE OF CONCENTRATIONS IN CHARACTERIZATION STEP SEDIMENT SAMPLES
FOCUSED FEASIBILITY STUDY
SITE 01 - McALLISTER POINT LANDFILL
NETC - NEWPORT, RI

	Near-shore (Sta. 12 to 14)	Off-shore (Sta. 15 and 16)	Out to 400' from shore (Sta. 17 to 20)	Controls (Sta. N-1 and N-2)
PARAMETER				
INORGANICS (μg/gm)				
Chromium (Total)	14-22	12-14	9-17	8-12
Copper (Total)	655-1,455	33-63	17-21	10-18
Lead (Total)	267-900	44-78	21-35	7-28
Nickel (Total)	55-87	17-20	11-18	11-21

TABLE 1-4

PHASE I REMEDIAL INVESTIGATION SAMPLE SUMMARY
FOCUSED FEASIBILITY STUDY
SITE 01 - McALLISTER POINT LANDFILL
NETC - NEWPORT, RI

MATRIX (SAMPLE TYPE)	NUMBER OF SAMPLES: ENVIRONMENTAL	DUPLICATE	FIELD BLANK	TRIP BLANK(1)	EPA SPLIT	ANALYSES(2)
SURFACE SOIL	15	2	–	3	–	A,B,C,D,E
	–	–	3		–	A,B,C,D
	4	1	1	1	–	A
	2	–	–	–	–	D
TEST BORINGS	26	3	–	–	–	A,B,C,D,E
	4	–	6	8	–	A,B,C,D
	1	–	–	–	–	A,D,E
	2	–	–	–	–	F
WELL BORINGS	10	–	–	–	–	A,B,C,D,E
	8	1	5	5	–	A,B,C,D
GROUND WATER	11	1	1	4	2	A,B,C,D
TAP WATER (3)	2	–	–	–	–	A,B,C,D
LEACHATE SPRING WATER	1	–	–	1	–	A,B,C,D

(1) – Trip blanks analyzed for volatile organic compounds only.
(2) – Analyses performed as follows:
A) Target Compound List Volatile Organic Compounds
B) Target Compound List Base Neutral/Acid Extractable Compounds
C) Target Compound List Pesticide/PCB Compounds
D) Target Analyte List (Metals & Cyanide)
E) 2,3,7,8-TCDD (Dioxin) Archived
F) TCLP Analysis
(3) – Samples of Tap Water Used In Equipment Decontamination.

2.0 IDENTIFICATION AND SCREENING OF REMEDIAL ACTIONS

Based on the available site information, potential source control remedial actions can be identified. Initially, remedial action objectives are developed in order to set goals for protecting human health and the environment early in the alternative development process. General response actions are then developed to address the objectives. Remedial technologies and process options associated with the general response actions are identified and screened to eliminate those that are not technically implementable and to identify those that offer the optimum combination of effectiveness, implementability and cost.

2.1 Superfund Program Expectations

Key to the development of remedial alternatives for a landfill site is the consideration of U.S. EPA's expectations for remediation of such sites under the Superfund program. Since many CERCLA landfill sites share similar characteristics, the U.S. EPA has established a number of expectations regarding the types of remedial alternatives that should be developed for detailed analysis at such sites. These expectations are listed in the National Contingency Plan [NCP, 40 CFR 300.430(a)(1)] and in U.S. EPA's guidance on Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites (U.S. EPA, 1991a), where they are outlined as follows:

- The principal threats posed by a site should be treated wherever practicable, such as in the case of remediation of a hot spot.
- Engineering controls, such as containment, will be used for waste that poses a relatively low long-term threat or where treatment is impracticable.
- A combination of methods will be used as appropriate to achieve protection of human health and the environment. An example of combined methods for a landfill site would be treatment of hot spots in conjunction with containment (capping) of the landfill contents.
- Institutional controls, such as deed restrictions, will be used to supplement engineering controls, as appropriate, to prevent exposure to hazardous wastes.
- Innovative technologies will be considered when such technologies offer the potential for superior treatment performance or lower costs for performance similar to that of demonstrated technologies.

- Ground water will be returned to beneficial uses whenever practical, within a reasonable time, given the particular circumstances of the site.

As discussed in the preamble to the NCP (Federal Register, Vol. 55, No. 46, page 8704), the expectations of the Superfund program also include the initiation of early action at sites where appropriate, and the remediation of sites in phases using operable units as early actions. Operable units are discrete actions that comprise incremental steps toward the final remedy, with total site remediation as the ultimate objective. This approach is particularly suited to a landfill site, as noted in the preamble to the NCP, which states the following:

> "A more streamlined analysis during an RI/FS may be particularly appropriate in the following circumstances: ....
>
> .... (when) many alternatives are clearly impracticable from the outset due to severe implementability problems or prohibitive costs (e.g., complete treatment of an entire large municipal landfill) and need not be studied in detail."

Also to be considered in the development of potential remedial actions is the framework established in the NCP [40 CFR 300.43(e)(2)(i)(A)(2)] which states that "The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available...". The 10^{-6} starting point indicates U.S. EPA's preference for setting cleanup levels at the more protective end of the acceptable 10^{-4} to 10^{-6} risk range for Superfund remedial actions. While no chemical-specific ARARs or TBCs are applicable to the implementation of a source control action at the McAllister Point Landfill site, the existing site conditions at pose potential risks to human health and the environment.

These expectations will guide the development of remedial action objectives and potential final source control remedial alternatives for the McAllister Point Landfill site.

2.2 Remedial Response Objectives

As discussed previously in Section 1.0, following completion of the Phase I RI at NETC, the four sites addressed within the RI were evaluated with respect to the potential threats to human health and the environment posed by the sites. The sites were evaluated to determine if there were specific media or areas of contamination which warrant early action to eliminate, reduce or control the hazards posed by the site or to expedite the completion of total site cleanup.

As presented in Section 1.7, the human health assessment which was conducted for the McAllister Point Landfill site on the basis of Phase I RI data indicated that the site poses human health risks which exceed the point of departure cancer risk of 1×10^{-6} and the acceptable non-cancer hazard index ratio of one (1). For exposures to site soils, ingestion of carcinogenic PAHs and inorganics (arsenic and beryllium) is the major contributor to the cancer risk estimates while ingestion of inorganics (copper and antimony) is the major contributor to the non-cancer risk calculations. For exposures to ground water, ingestion of inorganics (arsenic and beryllium) and carcinogenic PAHs is the major contributor to the cancer risk estimates while ingestion of inorganics (antimony, arsenic, cadmium, chromium, copper, manganese, mercury and zinc) is the major contributor to the non-cancer risk calculations.

Considering risks posed by the site under the current site use scenario (i.e., trespassing), the risks to potential trespassers due to the presence of contaminated soil fall within the acceptable risk range of 1×10^{-4} to 1×10^{-6}, but they exceed the point of departure risk level of 1×10^{-6}, justifying the consideration of site remediation options. While ingestion of ground water is not a current exposure pathway, leaching of contaminants from the landfill wastes due to the percolation of precipitation through the waste materials provides a continued pathway for contaminant migration to the ground water. Continued degradation of ground water quality and the potential for contaminant migration due to surficial erosion pose a potential risk to the environment due to the flow of ground water towards the bay. While additional assessment of potential human health and environmental risks posed by the site will be conducted as part of the Phase II RI, the presence of the landfill as a continued source of contamination to the environment justifies the consideration of a source control action. Therefore, stabilization of site conditions at McAllister Point Landfill was determined to be a high priority in addressing potential risks to human health and the environment at the NETC sites. Considering the site is a landfill for which many remedial alternatives are impracticable due to implementability or cost, the implementation of a remedial action to stabilize existing conditions (source control) was determined to be appropriate. In order to implement such an action, this Focused Feasibility Study (FFS) is being conducted to consider a limited number of remedial alternatives that are focused to achieving these goals.

The source control operable unit will be combined with a management of migration operable unit to form the final remedy for the site. Additional studies, either conducted as part of the Phase II RI and associated off-shore sampling effort (as described in Section 1.5.4) or conducted as part of the source control remedial design effort, will be required to determine what media will be addressed within the management of contaminant migration operable unit for the site. Based upon the results of these studies, the management of migration operable unit could include the following, as necessary:

- the treatment standards and remedial alternative(s) for vented landfill gases;
- the cleanup standards and remedial alternative(s) for hot spots within the landfill materials, if present;
- the cleanup standards and remedial alternatives(s) for contaminated ground water; and
- the cleanup standards and remedial alternative(s) for contaminated sediments.

By moving forward with this FFS, source control response actions can be fast-tracked while management of migration response actions or remediation of principal threats, if any are identified, can be further investigated, considered in the remedial response design phase and integrated into the design as appropriate to enhance the implementation of a final remedy for the site.

Based on this evaluation of the site and potential risks it poses to human health and the environment, the Remedial Action Objectives developed to guide the implementation of a source control response at the McAllister Point Landfill site are as follows:

- Minimize potential environmental impacts by minimizing off-site migration of surface soil contaminants, and by limiting the infiltration of precipitation to the underlying waste within the landfill area, thereby minimizing leachate generation; and
- Minimize potential risk to human health associated with exposure to the landfill area.

These Remedial Action Objectives will meet the goals of a source control response and will be consistent with the development of a management of migration operable unit for the site.

2.3 <u>General Response Actions</u>

General response actions are those remedial actions which will satisfy the Remedial Action Objectives. The first step in determining appropriate general response actions for McAllister Point Landfill is an initial determination of the areas or volumes to which the general response actions may be applied. In determining these volumes/areas, consideration has been given to site conditions, the nature and extent of contamination, acceptable exposure levels, and potential exposure routes, as well as U.S. EPA's stated objectives and expectations for the Superfund program (see Section 2.1).

In identifying the area or volume to which general response actions would be applicable in achieving source control at McAllister Point Landfill, the area of the site in which wastes were disposed of must be evaluated. Subsurface investigations identified the presence of fill materials in every boring (including monitoring well borings) drilled west of the railroad tracks, with the exception of B-10 in the southernmost portion of the site (see Figure 1-15). The landfill material observed during the drilling and sampling activities appeared to be generally separated into three broad categories of waste, consisting of domestic-type refuse, demolition/construction waste and incinerator ash. The central, mounded portion of the landfill was found to contain domestic-type refuse (i.e., plastic bags, rags, newspaper, etc.), as evidenced in borings B-3, B-5, B-6, B-7, B-11 and the boring for monitoring well MW-3S/D. The remainder of the soil borings exhibited waste typical of building demolition debris (i.e., wood, metal, bric, concrete, etc.). Incinerator ash was encountered mostly in the northwest portion of the site (in borings B-1, B-2, B-4, and the well boring for MW-2S) and was also encountered in boring B-9 in the southern portion of the site. Both ash and demolition debris were observed in borings B-2, B-4, B-9 and the well boring MW-2.

Based on the widespread presence of fill materials across the site, it was determined that the entire landfill portion of the site located west of the railroad tracks (estimated to be approximately 10.5 acres in area) must be addressed to respond to the potential risks the site poses to human health and the environment.

Consideration was also given to the possibility of separately addressing hot spots as part of the remedial action. A potential area which could warrant consideration as a possible hot spot area is the area along the shoreline of the site, where elevated inorganic (e.g., lead, copper, antimony, arsenic and beryllium) concentrations were detected. However, the presence of elevated inorganic levels in background surface soil samples indicates the presence of the inorganics may not be site-related. For example, the majority of the shoreline surface soil sample lead concentrations (384 to 474 ppm) were not significantly elevated above background SS-17 (lead at 314 ppm), with the exception of SS-15 (lead at 1,980 ppm). Therefore, further evaluation of site-specific background inorganic levels within the Phase II RI is appropriate prior to determining if the detected inorganic levels pose a principal threat which should be addressed separately as a hot spot, or if the majority of the detected levels are representative of background conditions. Shoreline soils/sediments and background soil quality will be further evaluated as part of the Phase II RI, and will be addressed within the management of migration operable unit, as necessary.

Two potential hot spot areas were identified on the basis of visual observations during the Phase I RI. One of these two areas is in the vicinity of MW-5S, where a thin layer of oil was identified on the ground water surface during one round of water level measurements. However, no visible subsurface source of the oil contamination was observed during the drilling of wells MW-5S/D (reference boring logs in Appendix G of the Remedial Investigation Technical Report, TRC, 1991) and no excessive contaminant levels were detected in the subsurface soils. Therefore, this area is not considered to be a source control hot-spot area on the basis of Phase I RI results. Additional monitoring wells will be installed within the vicinity of wells MW-5S/D during the Phase II RI to further investigate this area.

The second potential hot-spot area based on visual observations during the Phase I RI is the area of the site in which ash residue from on-site incineration activities was disposed of. Based on the chemical analysis of Phase I samples, however, the ash residue disposal area has not been identified as a potential hot spot area. Additional investigations of the ash materials will be conducted during the Phase II RI.

Based on this analysis, a general response action involving removal or treatment of hot spot areas has not been developed for the site, based upon the currently defined nature and extent of contamination. The potential hot spot areas will be further evaluated upon the completion of Phase II remedial investigations to determine if any of these areas pose a principal threat to human health or the environment which warrants remediation either through consolidation within the limits of the source control remedial action or through a separate remedial action.

The general response actions selected to address the source control RAOs at McAllister Point Landfill include the following:

- No-Action
- Limited Action
- Containment

2.4 Identification and Screening of Technologies and Process Options

The general response actions are developed further through the identification and screening of remedial technologies which could potentially meet the remedial response objectives and cleanup criteria. Following a screening of the remedial technologies on the basis of technical implementability, the process options associated with each technology are screened based on effectiveness, implementability, and cost. Representative process options are chosen for inclusion in the remedial alternatives developed for the site.

2.4.1 Technology Screening

The technology screening performed for McAllister Point Landfill is presented in Table 3-1. The tables include brief descriptions of the individual technologies or process options, and comments on their technical implementability. All technologies and process options were determined to be technically implementable and were retained for further evaluation within the process option screening.

2.4.2 Process Option Screening

Upon identification of those technologies which are technically implementable, the process options are further evaluated to allow the selection of representative process options to be used in the development of remedial alternatives. The process options are evaluated on the basis of effectiveness, implementability, and cost. The process option screening is presented in Table 3-2. The selected representative process options are indicated with a bullet. In accordance with the NCP, no action is retained for further consideration. Institutional controls are retained, including both fencing and deed restrictions, to limit exposures to the site under both existing and future conditions. For the containment alternatives, surface controls including grading and revegetation are retained for further consideration, as are the RCRA Subtitle C (hazardous waste) and Subtitle D (municipal solid waste) capping requirements. Based on the reported and documented presence of municipal-type wastes within the landfill (as evidenced by on observations of subsurface plastic, paper and garbage made during Phase I RI drilling activities within the landfill area), consideration of a RCRA Subtitle D cap was retained for further analysis. Wastes which could be expected to be characterized as hazardous wastes under current RCRA definitions (e.g., solvents) were reportedly disposed of in the landfill, although observations made during Phase I site investigations identified only domestic, industrial/ construction or demolition-type debris (e.g. wood, metal, brick, concrete, etc.) and incinerator ash (i.e., no drums or other evidence of hazardous material disposal was observed). However, based on the reported disposal of wastes which could be considered hazardous wastes under current definitions, a RCRA Subtitle C cap was also retained for further consideration. Consideration of these two capping scenarios provides a range of capping options. The RCRA Subtitle D cap meets federal solid waste capping requirements but does not meet RIDEM solid waste capping requirements. RIDEM solid waste capping requirements are more stringent than RCRA Subtitle D capping requirements, but are similar to but not as stringent as RCRA Subtitle C capping requirements. Therefore, a RCRA Subtitle C multi-layer cap is considered to meet both RCRA hazardous waste and RIDEM solid waste landfill closure requirements. Since RIDEM hazardous waste landfill closure requirements incorporate RCRA Subtitle C requirements by reference, these requirements would also be met by a RCRA Subtitle C cap.

2.5 Remedial Alternative Development

The selected technologies and process options identified in Section 2.4.2 are combined in this section to form remedial alternatives. The developed range of alternatives is intended to provide a streamlined evaluation of possible remedial actions which will meet the objectives of this source control action. The alternatives presented herein have been developed in accordance with the expectations of the Superfund program, as outlined within the NCP and previously described in Section 2.1. The remedial alternatives for McAllister Point Landfill are presented in Table 2-3, and are listed below:

- **Alternative 1** - No Action
- **Alternative 2** - Fencing, Surface Controls, and Deed Restrictions
- **Alternative 3** - RCRA Subtitle D Soil Cap with Surface and Institutional Controls
- **Alternative 4** - RCRA Subtitle C Multi-layer Cap with Surface and Institutional Controls

Under Alternative 1, the no action alternative, the site would not be remediated. Under the second alternative, a limited action scenario, the site would be fenced, limited surface controls would be implemented to enhance drainage but minimize erosion, and restrictions would be placed on future site use. Alternatives 3 and 4 were developed to reduce contaminant mobility and potential exposures to contaminated surficial materials, through the construction of either a soil cap or a multi-layer cap over the landfill area. Alternatives 3 and 4 would also utilize institutional controls to ensure that the site is never developed for alternate land uses (e.g., residential use) and surface controls to enhance the effectiveness of the cover system. Another required component of Alternatives 3 and 4 is the implementation of additional site investigation activities required to evaluate the potential remediation of hot spots, sediment, ground water, and landfill gas within a separate management of migration operable unit for the site.

TABLE 2-1
REMEDIAL TECHNOLOGY SCREENING
SOURCE CONTROL
FOCUSED FEASIBILITY STUDY
SITE 01 - McALLISTER POINT LANDFILL
NETC - NEWPORT, RI

☐ Screened on Basis of Technical Implementability

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	COMMENTS
No Action	None	Not Applicable	No action.	Required for consideration under the NCP.
Institutional Control	Site Use Restrictions	Deed Restrictions	Deed for site would be revised to include restrictions on future site use or development, limiting future exposures to site contaminants.	Potentially applicable.
		Fencing	Fencing and posting of warning signs to limit public access and exposure to site contaminants.	While public access to the site is currently limited, additional fencing could further limit access.
Containment	Surface Controls	Grading	Grading would reshape topography to minimize poor drainage areas, run-on, run-off and soil erosion.	Potentially viable; would eliminate existing areas where precipitation tends to pond; may be combined with the implementation of other technologies (e.g., capping).
		Revegetation	By adding or maintaining vegetation on the surface of the site, erosion is minimized.	Existing site is fairly well-covered by vegetation; may be combined with the implementation of other technologies (e.g., capping).

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TABLE 2-1 (Continued)
REMEDIAL TECHNOLOGY SCREENING
SOURCE CONTROL
FOCUSED FEASIBILITY STUDY
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

☐ Screened on Basis of Technical Implementability

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	COMMENTS
Containment (Cont.)	Capping	Asphalt	Paving of site with bituminous material.	Potentially viable, minimizes direct exposure and limits infiltration; does not meet state or federal landfill closure requirements.
		Concrete	Paving of site with concrete.	Potentially viable, minimizes direct exposure and limits infiltration; does not meet state or federal landfill closure requirements.
		RCRA Subtitle D Soil Cap	Capping of site with compacted earth, including an 18-inch infiltration layer and a 6-inch erosion layer.	Potentially viable, minimizes direct exposure and limits infiltration; does not meet state solid waste landfill closure requirements.
		RI Solid Waste Landfill Cap	Capping of site with multi-layer cap consisting of a vegetative layer, drainage layer, a geomembrane or low permeability soil barrier, and a bedding layer.	Potentially viable, minimizes direct exposure and limits infiltration; meets state and federal solid waste landfill closure requirements.
		RCRA Subtitle C Multi-Layer Cap	Placement of multi-layer cap, consisting of vegetative, drainage, combined soil and geosynthetic barrier and bedding layers over site.	Potentially viable, minimizes infiltration and direct exposure; meets state and federal hazardous waste landfill closure requirements.

TABLE 2-2
PROCESS OPTION SCREENING
SOURCE CONTROL
FOCUSED FEASIBILITY STUDY
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

● Representative Process Option

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST
No Action	None	Not Applicable	● Is not effective in addressing soil contamination which exceeds TBCs or risk-based cleanup levels.	No implementation is required.	No cost.
Institutional Control	Site Use Restrictions	Deed Restrictions	● Limits disturbance of existing contamination, unacceptable future site use, or introduction of additional contaminated materials.	Requires appropriate legal authority.	Low capital cost.
		Fencing	● Limits human exposure to site.	Easily implemented.	Low capital cost; low maintenance cost.
Containment	Surface Controls	Grading	● Limits infiltration through elimination of poor drainage areas, minimizes or controls run-on and run-off and limits erosion of surficial contaminants.	Fairly easily implemented.	Low capital cost; low maintenance cost.
		Revegetation	● Limits erosion due to the soil-holding characteristics of vegetative cover.	Site is fairly well covered by vegetation under existing conditions; if surface is disturbed by other activities, revegetation would be fairly easily implemented.	Low capital cost; low maintenance cost.

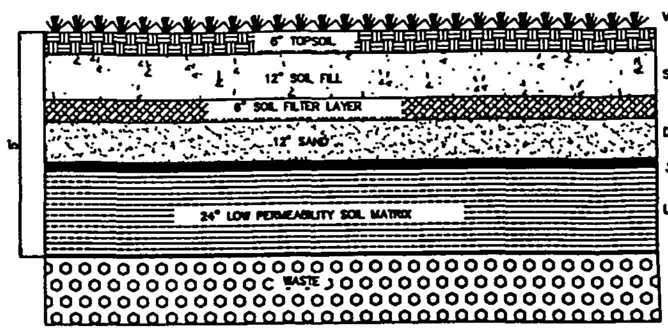
TABLE 2-2 (Continued)
PROCESS OPTION SCREENING
SOURCE CONTROL
FOCUSED FEASIBILITY STUDY
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

● Representative Process Option

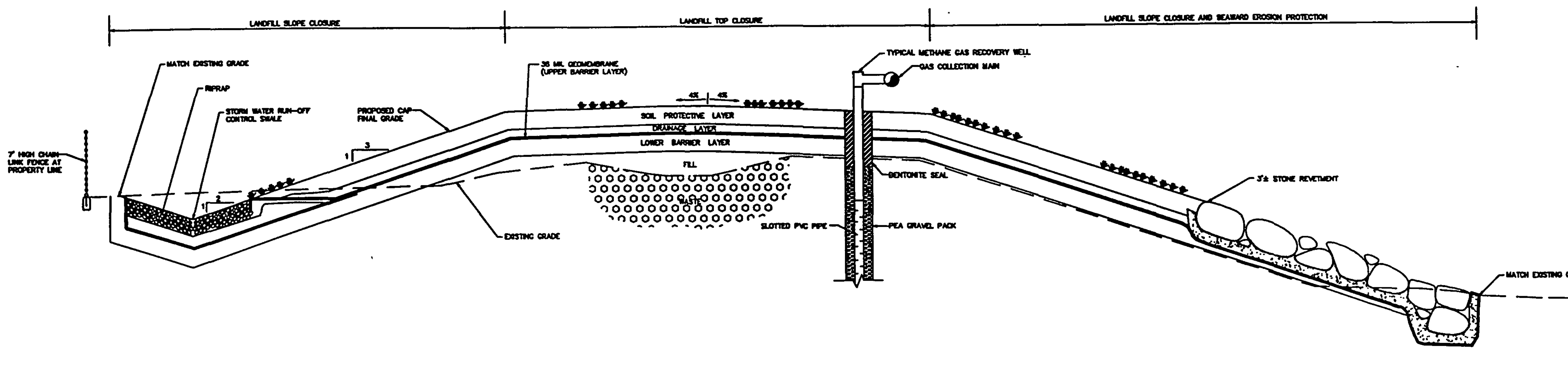
GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST
Containment (Cont.)	Capping	Asphalt	Susceptible to weathering and cracking; effective in limiting direct contact with contaminated soils.	Fairly easily implemented; requires future land use restrictions, stripping of existing vegetation and regrading of the site.	Moderate capital; moderate maintenance.
		Concrete	Susceptible to weathering; effective in limiting direct contact with contaminated soils and infiltration.	Fairly easily implemented; requires future land use restrictions, stripping of existing vegetation and regrading of the site.	Moderate to high capital; moderate maintenance.
		RCRA Subtitle D Soil Cap	● Most easy to maintain; provides some protection against infiltration; easily supports vegetative cover; effective in limiting direct contact with soils.	Fairly easily implemented; requires future land use restrictions, stripping of existing vegetation and regrading of the site.	Moderate capital; low to moderate maintenance.
		RI Solid Waste Landfill Cap	Similar in effectiveness to RCRA Subtitle C cap but more effective than RCRA Subtitle D cap; effective in limiting infiltration and direct contact with soils.	Multi-layer design complicates construction; requires future land use restrictions, stripping of existing vegetation and regrading of the site.	Moderate to high capital; moderate maintenance.
		RCRA Subtitle C Multi-Layer	● Susceptible to physical damage; effective in limiting direct contact with contaminated soils, infiltration of precipitation, and leachate seeps.	Multi-layer design complicates construction; requires future land use restrictions, stripping of existing vegetation, regrading of the site and specialized construction methods.	Moderate to high capital; moderate maintenance.

TABLE 2–3
REMEDIAL ALTERNATIVE DEVELOPMENT SUMMARY
SOURCE CONTROL
FOCUSED FEASIBILITY STUDY
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

GENERAL RESPONSE ACTION	TECHNOLOGY TYPE	AREA OR VOLUME	REMEDIAL ALTERNATIVES			
			1 NO ACTION	2 LIMITED ACTION	3 SOURCE CONTROL – CAPPING	4 SOURCE CONTROL – CAPPING
No Action	Not Applicable	Not Applicable	●			
Institutional Controls	Deed Restrictions	Entire Site		●	●	
	Fencing	Entire Site		●	●	
Containment	Grading	Poor Drainage Areas		●		
		Entire Site			●	
	Revegetation	Unvegetated Areas		●		
		Entire Site			●	
	RCRA Subtitle D Cap	Entire Site			●	
	RCRA Subtitle C Cap	Entire Site				



CAP DETAIL
NOT TO SCALE



TYPICAL SECTION THROUGH LANDFILL CAP
NOT TO SCALE

TRC
TRC Environmental Corporation

NAVAL EDUCATION & TRAINING CENTER — NEWPORT RHODE ISLAND

FIGURE 3-4
McALLISTER POINT LANDFILL
PROPOSED RCRA SUBTILE C
MULTI-LAYER CAP DETAILS

		SCALE	PROJ. NO.
DRAWN	RFM	DATE	DWG. NO. C2-LNDFL
APPROVED	RJN		

c:\1277J\c2-lndfl

TABLE 3-1
FEDERAL LOCATION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 1: NO ACTION
ALTERNATIVE 2: FENCING, SURFACE CONTROLS AND DEED RESTRICTIONS

MEDIA	REQUIREMENT	STATUS	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Wetlands/Water Resources--				
	Executive Order 11988 and 11990; Statement on Proceedings of Floodplain Management and Wetlands Protection (40 CFR 6, Appendix A)	Applicable	Requires action to avoid whenever possible the long- and short-term impacts associated with the destruction of wetlands and the occupancy and modifications of floodplains and wetlands whenever there is a practicable alternative which promotes the preservation and restoration of the natural and beneficial values of wetlands and floodplains.	Will be applicable if implementation of a remedial action impacts coastal or on-shore wetland areas. Since these alternatives do not impact wetlands, they meet this ARAR.
	Clean Water Act Section 404 (40 CFR 230.10) Requirements for Discharge of Dredge or Fill Material and Rivers and Harbors Act (Section 10) Prohibition of Filling a Navigable Water	Applicable	Prohibits the discharge of dredged or fill material to a water of the United States if there is a practicable alternative which poses less of an adverse impact on the aquatic ecosystem or if it causes significant degradation of the water. Rivers and Harbors Act prevents filling of a navigable water.	Although these remedial alternatives do not impact wetlands and waters, they permit continued contamination and therefore do not meet this ARAR.
	Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 661) Protection of Wildlife Habitats	Applicable	Requires consultation with federal and state conservation agencies during planning and decision-making process which may impact water bodies, including wetlands. Measures to prevent, mitigate or compensate for losses of fish and wildlife will be given due consideration whenever a modification of a water body is proposed.	If the implementation of a remedial action results in an impact to a water body, consultation with U.S. Fish and Wildlife Service, RIDEM, and other federal and state agencies involved in fish and wildlife matters is required. ARAR for fencing.

TABLE 3-1 (Continued)
FEDERAL LOCATION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 1: NO ACTION
ALTERNATIVE 2: FENCING, SURFACE CONTROLS AND DEED RESTRICTIONS

MEDIA	REQUIREMENT	STATUS	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Coastal Zones--				
	Coastal Zone Management Act (16 USC Section 1451 et seq.)	Applicable	Regulates activities affecting the coastal zone including lands thereunder and adjacent shoreline.	For remedial actions in coastal zone, requires determination that all activities are consistent to the maximum extent practicable with State Coastal Zone Management Plan. ARAR for fencing.
Endangered Species--				
	Endangered Species Act of 1973 (16 U.S.C. 1531) Protection of Endangered Species	To be determined	Restricts activities in areas inhabited by registered endangered species.	Potential ARAR for activities which could impact endangered or threatened wildlife species. Potential ARAR for fencing.
Cultural Resources--				
	National Historic Preservation Act of 1966 (16 USC 470, et seq.) Protection of Historic Lands and Structures; Archeological and Historic Preservation Act of 1974 (132 CFR 229 & 229.4, 43 CFR 7 & 7.4); Historic Sites, Building and Antiquities Act.	Applicable	Several statutes which govern the preservation at historic, scientific and archeological sites and resources. Includes action to recover and preserve artifacts, preserve historic properties and minimize harm to National Historic Landmarks.	Remedial actions must be coordinated with preservation agencies and societies to minimize loss of significant scientific, prehistoric, historic or archeological data. ARAR for fencing.

TABLE 3-2
STATE LOCATION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 1: NO ACTION
ALTERNATIVE 2: FENCING, SURFACE CONTROLS AND DEED RESTRICTIONS

MEDIA	REQUIREMENT	STATUS	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Wetlands--				
	Rhode Island Wetlands Laws (RIGL 2-1-18 et seq.); Rhode Island Department of Environmental Management Rules Governing the Enforcement of the Freshwater Wetlands Act - as amended, Dec. 21, 1986.	Applicable	Defines and establishes provisions for the protection of swamps, marshes and other freshwater wetlands in the state. Actions required to prevent the undesirable drainage, excavation, filling, alteration, encroachment of any other form of disturbance or destruction to a wetland.	Regulation will be applicable if implementation of a remedial action impacts a wetland area. Since these alternatives do not impact wetlands, they meet this ARAR. However, no action permits continued degradation of wetlands which does not meet this ARAR.
Coastal Zone--				
	Rhode Island Coastal Resources Management Law, (RIGL, Title 46, Chapter 23) and Regulations	Applicable	Creates Coastal Resources Management Council and sets standards and authorizes promulgation of regulations for management and protection of coastal resources.	Since McAllister Point Landfill is located in a coastal area, the lead agency will coordinate with the Rhode Island Coastal Resources Management Council and will ensure that all actions are consistent, to the maximum extent practicable, with the Coastal Zone Management Plan. ARAR for fencing.

TABLE 3-3
FEDERAL ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 2: FENCING, SURFACE CONTROLS AND DEED RESTRICTIONS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	ACTION TAKEN TO MEET ARAR
Drainage	Clean Water Act (40 CFR 122-125) National Pollutant Discharge Elimination System (NPDES) Permit Requirements	Applicable	Permits contain applicable effluent standards (i.e. technology - based and/or water quality - based), monitoring requirements, and standards and special conditions for discharges, including storm water discharges from land disposal facilities which have received industrial waste from industrial facilities.	Storm water drainage improvements would be designed to provide compliance with these regulations and drainage would be monitored in compliance with these regulations.

TABLE 3-4
STATE ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 2: FENCING, SURFACE CONTROLS AND DEED RESTRICTIONS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	ACTION TAKEN TO MEET ARAR
Drainage	RI Water Pollution Control Act			
	• RI Water Quality Regulations for Water Pollution Control (RIGL 46-12, et seq.)	Applicable	Establishes general requirements and effluent limits for discharge to area waters.	In compliance with these regulations, RIPDES requirements pertaining to storm water discharges would be met.
	• Regulations for the RI Pollutant Discharge Elimination System (RIPDES) (RIGL 46-12, et seq.)	Applicable	Permits contain applicable effluent (i.e. technology - based and/or water quality - based), monitoring requirements, and standards and special conditions for discharges, including storm water discharges from land disposal facilities which have received industrial waste.	Storm water discharge improvements would be designed to provide compliance with these regulations and drainage would be monitored in compliance with these regulations.

TABLE 3-5
ALTERNATIVE 2 COST ESTIMATE
FENCING, SURFACE CONTROLS AND DEED RESTRICTIONS
FOCUSED FEASIBILITY STUDY
SITE 01 - McALLISTER POINT LANDFILL
NETC - NEWPORT, RI

Item	Quantity	Units	Unit Price	Basis Year	Reference	Escalation	1993 Unit Costs	1993 Costs	Years (O&M)	Present Value (O&M) (1)
CAPITAL COST - DIRECT										
Site Access Restrictions										
- Chain Link, 9 gauge wire, aluminized steel, 6' high, plus 3 strands barbed wire	4,800	l. ft.	$15.45	1993	1	1.000	$15.45	$74,160.00		
- Double Swing Gate 6' high, 20' opening	1	each	$890.00	1993	1	1.000	$890.00	$890.00		
- Warning Signs	48	each	$43.00	1993	1	1.000	$43.00	$2,064.00		
Subtotal - Site Access Restrictions										$77,114.00
Surface Controls										
- Regrading of Poor Drainage Areas	5,300	cu. yd.	$4.90	1993	1	1.000	$4.90	$25,970.00		
- Furnish and Place Soil Over Poor Soil Cover Areas (6" deep)	7,300	sq. yd.	$4.04	1993	1	1.000	$4.04	$29,492.00		
- Health & Safety (17%)								$9,428.54		
- Fine Grade and Seed	15,200	sq. yd.	$1.89	1993	1	1.000	$1.89	$28,728.00		
Subtotal - Surface Controls										$93,618.54
Total Direct Capital Cost										$170,732.54
CAPITAL COST - INDIRECT										
Engineering and Design (10 %)					2					$17,073.25
Legal and Administrative (4%)					2					$6,829.30
TOTAL CAPITAL COSTS										$194,635.10

TABLE 3–5 (Continued)
ALTERNATIVE 2 COST ESTIMATE
FENCING, SURFACE CONTROLS AND DEED RESTRICTIONS
FOCUSED FEASIBILITY STUDY
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

Item	Quantity	Units	Unit Price	Basis Year	Reference	Escalation	1993 Unit Costs	1993 Costs	Years (O&M)	Present Value (O&M) (1)
OPERATION AND MAINTENANCE COSTS										
Site Fence Maintenance	1	each	$500.00	1988	3	1.130	$565.00	$565.00	30	$8,685.18
Surface Water Discharge Monitoring										
– Collection and Reporting	1	lump sum	$15,000.00	1993	5	1.000	$15,000.00	$15,000.00	30	$230,580.00
– Sample Analysis	2	each	$1,630.00	1993	6	1.000	$1,630.00	$3,260.00	30	$50,112.72
TOTAL NET PRESENT VALUE OF O & M								$18,825.00		$289,377.90
SUBTOTAL COST										$484,013.00
CONTINGENCY (20%)										$96,802.60
TOTAL PRESENT VALUE COST FOR ALTERNATIVE 2 – FENCING, SURFACE CONTROLS AND DEED RESTRICTIONS										$580,815.59

(1) – Calculated based on 5% interest rate.

TABLE 3–6
FEDERAL LOCATION–SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC – NEWPORT
ALTERNATIVE 3: RCRA SUBTITLE D SOIL CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS
ALTERNATIVE 4: RCRA SUBTITLE C MULTI–LAYER CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

MEDIA	REQUIREMENT	STATUS	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Wetlands/Water Resources––				
	Executive Order 11988 and 11990; Statement on Proceedings of Floodplain Management and Wetlands Protection (40 CFR 6, Appendix A)	Applicable	Requires action to avoid whenever possible the long– and short–term impacts associated with the destruction of wetlands and the occupancy and modifications of floodplains and wetlands whenever there is a practicable alternative which promotes the preservation and restoration of the natural and beneficial values of wetlands and floodplains.	Will be applicable if implementation of the cap or or associated shoreline protection impacts coastal or on–shore wetlands.
	Clean Water Act Section 404 (40 CFR 230.10) Requirements for Discharge of Dredge or Fill Material and Rivers and Harbors Act (Section 10) Prohibition of Filling a Navigable Water	Applicable	Prohibits the discharge of dredged or fill material to a water of the United States if there is a practicable alternative which poses less of an adverse impact on the aquatic ecosystem or if it causes significant degradation of the water. Rivers and Harbors Act prevents filling of a navigable water.	Applicable to the construction of a cap and associated shoreline protection along Narragansett Bay.
	Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 661) Protection of Wildlife Habitats	Applicable	Requires consultation with federal and state conservation agencies during planning and decision–making process which may impact water bodies, including wetlands. Measures to prevent, mitigate or compensate for losses of fish and wildlife will be given due consideration whenever a modification of a water body is proposed.	If the implementation of a remedial action results in an impact to a water body, consultation with U.S. Fish and Wildlife Service, RIDEM, and other federal and state agencies involved in fish and wildlife matters is required. ARAR for construction of a cap and associated shoreline protection along Narragansett Bay.

TABLE 3-6 (Continued)
FEDERAL LOCATION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 3: RCRA SUBTITLE D SOIL CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS
ALTERNATIVE 4: RCRA SUBTITLE C MULTI-LAYER CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

MEDIA	REQUIREMENT	STATUS	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Endangered Species--				
	Endangered Species Act of 1973 (16 U.S.C. 1531) Protection of Endangered Species	To be determined	Restricts activities in areas inhabited by registered endangered species.	Potential ARAR for activities which could impact endangered or threatened wildlife species. Potential ARAR for cap construction.
Cultural Resources--				
	National Historic Preservation Act of 1966 (16 USC 470, et seq.) Protection of Historic Lands and Structures; Archeological and Historic Preservation Act of 1974 (132 CFR 229 & 229.4, 43 CFR 7 & 7.4); Historic Sites, Building and Antiquities Act.	Applicable	Several statutes which govern the preservation at historic, scientific and archeological sites and resources. Includes action to recover and preserve artifacts, preserve historic properties and minimize harm to National Historic Landmarks.	Remedial actions must be coordinated with preservation agencies and societies to minimize loss of significant scientific, prehistoric, historic or archeological data. ARAR for cap construction.

TABLE 3-7
STATE LOCATION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 3: RCRA SUBTITLE D SOIL CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS
ALTERNATIVE 4: RCRA SUBTITLE C MULTI-LAYER CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

MEDIA	REQUIREMENT	STATUS	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Wetlands--				
	Rhode Island Wetlands Laws (RIGL 2-1-18 et seq.); Rhode Island Department of Environmental Management Rules Governing the Enforcement of the Fresh-water Wetlands Act - as amended, Dec. 21, 1986.	Applicable	Defines and establishes provisions for the protection of swamps, marshes and other freshwater wetlands in the state. Actions required to prevent the undesirable drainage, excavation, filling, alteration, encroachment of any other form of disturbance or destruction to a wetland.	Regulation will be applicable if cap construction impacts a wetland area.
Coastal Zone--				
	Rhode Island Coastal Resources Management Law, (RIGL, Title 46, Chapter 23) and Regulations	Applicable	Creates Coastal Resources Management Council and sets standards and authorizes promulgation of regulations for management and protection of coastal resources.	Since McAllister Point Landfill is located in a coastal area, the lead agency will coordinate with the Rhode Island Coastal Resources Management Council and will ensure that all actions are consistent, to the maximum extent practicable, with the Coastal Zone Management Plan. ARAR for capping.

TABLE 3-8
FEDERAL ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 3 - RCRA SUBTITLE D SOIL CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	ACTION TAKEN TO MEET ARAR
Capping	RCRA (40 CFR 258) Criteria for Municipal Solid Waste Landfills (Subtitle D)	Relevant and Appropriate	Outlines specifications and standards for the location, operation, design, monitoring, and closure of municipal solid waste landfills.	Substantive RCRA Subtitle D requirements would be met and adhered to on-site.
	• 40 CFR 258.60 - Closure Criteria for Municipal Solid Waste Landfills	Relevant and Appropriate	Requires and establishes guidelines for design of a municipal landfill final cover system.	Substantive standards and requirements will be met.
	• 40 CFR 258.61 - Post Closure Care Requirements for Municipal Solid Waste Landfills	Relevant and Appropriate	Establishes requirements for maintaining integrity and effectiveness of cover, and other monitoring systems.	Substantive standards and requirements will be met.
	RCRA (40 CFR 264) Subtitle C Requirements:	Relevant and Appropriate	Outlines specifications and standards for design, operation, closure and monitoring of performance for hazardous waste storage, treatment and disposal facilities.	ARAR would not be met.
	Migratory Bird Treaty Act (16 U.S.C. 703-712)	Applicable	Prohibits hunting, possessing, killing, or capturing of migratory birds, birds in danger of extinction, and those birds' eggs or nests.	Since construction activities during the breeding season may "take" birds or their nests, actions must be taken to avoid destroying nests during breeding season. Phase II environmental assessments will determine if migratory birds live in or around the landfill area.
	Clean Water Act Section 404 (40 CFR 230.10) Requirements for Discharge of Dredged or Fill Material and Rivers and Harbors Act (Section 10) Prohibition of Wetland Filling	Applicable	Prohibits the discharge of dredged or fill material to waters of the United States unless no other practical alternatives are available which pose less of an adverse impact on the aquatic ecosystem or if it causes significant degradation of the water.	Potential ARARs for alternatives conducted in or around adjacent wetlands.

TABLE 3-8 (Continued)
FEDERAL ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 3 - RCRA SUBTITLE D SOIL CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	ACTION TAKEN TO MEET ARAR
Venting	Clean Air Act (40 CFR 50) New Source Performance Standards (NSPS) Proposed Subpart WWW 56 FR 24468-24528 (5/30/91)	To Be Considered	Requires Best Demonstrated Technology (BDT) for new sources, and sets emissions limitations. Proposed Subpart WWW sets a performance standard for non-methane organic compounds (NMOC) emissions of 150 Mg/yr (167 tpy) for existing municipal solid waste landfills.	These standards should be considered in the design of a landfill gas management system.
	Clean Air Act (40 CFR 61) National Emissions Standards for Hazardous Pollutants (NESHAPS)	To Be Considered	Establishes emissions limitations for hazardous air pollutants and sets forth regulated sources of those pollutants.	Although EPA has not promulgated final Maximum Achievable Control Technology (MACT) standards for municipal landfills, the lead agency should use air control technology to control emissions of hazardous air pollutions. MACT standards prescribe technology that is used by the best 12% of industries in the source category.
	Clean Air Act, Section 5 171 through 178, 42 USC §§ 7471-7478 (Requirements for Non-Attainment Areas)	Applicable or Relevant and Appropriate (Depending on Modelling Results)	RI has adopted State Implementation Plan (SIP) requirements approved and enforcable by EPA which meet the New Source Review (NSR) requirement of the CAA. These provisions require that new or modified major sources of VOCs defined as a source which has the potential to emit 25 tpy) install equipment to meet Lowest Available Emissions Rate (LAER), which is set on a case-by-case basis and is either the most stringent emissions limitation contained in any SIP for that category or source or the most stringent emissions limitation which is achieved for the source. NSR requirements apply to non-attainment pollutants, which are VOCs and NO_x in RI.	Monitoring will be conducted to determine if the requirements of this standard are applicable or relevant and appropriate based on the emissions levels and on the need to be protective of human health and the environment.

TABLE 3-8 (Continued)
FEDERAL ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 3 - RCRA SUBTITLE D SOIL CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	ACTION TAKEN TO MEET ARAR
	Clean Air Act, Section 5 160 through 169A - Prevention of Significant Deterioration Provisions	Applicable or Relevant and Appropriate (Depending on Modelling Results)	RI has adopted SIP requirements approved and enforceable by EPA which meet the New Source Review (NSR) requirements of the CAA. These provisions require that new or modified major sources of VOCs (defined as a source which has the potential to emit 25 tons/year) install equipment to meet Lowest Available Emissions Rate (LAER), which is set on a case-by-case basis and is either the most stringent emissions limitation contained in any SIP for that category or source or the most stringent emissions limitation which is achieved for the source. NSR requirements apply to non-attainment pollutants, which are VOCs and NO_x in RI.	Monitoring will be conducted to determine if the requirements of this standard are applicable or relevant and appropriate based on the emissions levels.
Drainage	Clean Water Act (40 CFR 122-125) National Pollutant Discharge Elimination System (NPDES) Permit Requirements	Applicable	Permits contain applicable effluent standards (i.e., technology-based and/or water quality-based), monitoring requirements, and standards and special conditions for discharges, including storm water discharges from land disposal facilities which have received industrial waste from industrial facilities.	Storm water drainage improvements would be designed to provide compliance with the substantive requirements of these regulations and drainage would be monitored in compliance with these reguations.

TABLE 3-9
STATE ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 3 - RCRA SUBTITLE D SOIL CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Capping	RI Refuse Disposal Law Rules and Regulations and Proposed Amendments for Solid Waste Management Facilities	Relevant and Appropriate	Rules and regulations intended to minimize environmental hazards associated with the operation of solid waste transfer, resource recovery, and disposal facilities.	ARARs for final cap design would not be met.
	RI Hazardous Waste Management Act of 1978 (RIGL 23-19.1 et seq.) Hazardous Waste Management Rules and Regulations and Proposed Amendments:	Relevant and Appropriate	Rules and regulations intented to minimize environmental hazards associated with the operation of hazardous waste treatment, storage, and disposal facilities.	ARARs for final cap design would not be met.
Venting	RI Clean Air Act (RIGL, Title 23, Chapter 23) General Air Quality and Air Emissions Requirements • RI Air Pollution Control Regulations, RI Dept. fo Health, Div. of Air Pollution Control, effective 8/2/67, most recently amended 5/20/91			
	- Regulation No. 1 - Visible Emissions	Applicable	No air contaminant emissions will be allowed for more than 3 minutes in any one hour which are greater than or equal to 20% opacity.	Air emissions from remedial actions will meet emission levels in regulation.
	- Regulation No. 5 - Fugitive Dust	Applicable	Requires that reasonable precaution be taken to prevent particulate matter from becoming airborne.	On-site remedial actions will use good industrial practices to prevent particulate matter from becoming airborne.

TABLE 3-9 (Continued)
STATE ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 3 - RCRA SUBTITLE D SOIL CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
	- Regulation No. 7 - Emissions Detrimental to Person or Property	Applicable	Prohibits emissions of contaminants which may be injurious to human, plant or animal life or cause damage to property or which reasonably interferes with the enjoyment of life and property.	All emissions from landfill vents will meet this requirement or gas treatment will be required.
	- Regulation No. 15 - Control of Organic Solvent Emissions	Applicable	Limits the amount of organic solvents emitted to the atmosphere.	If emissions from landfill gas vents exceed limits in this regulation, emission controls will be designed and implemented to meet these requirements.
	- Regulation No. 17 - Odors	Applicable	Prohibits the release of objectionable odors across property lines.	No remedial action or air emissions will emit objectionable odors beyond the facility boundary, as practicable.
	- Regulation No. 22 - Air Toxics	Applicable if air emissions contain regulated substances	Prohibits the emission of specified contaminants at rates which would result in ground level concentrations greater than acceptable ambient levels or acceptable ambient levels with LAER, as set in the regulation.	If necessary to meet these standards, air emissions control equipment will be designed for landfill gas emissions control.

TABLE 3-9 (Continued)
STATE ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 3 - RCRA SUBTITLE D SOIL CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Drainage	RI Water Pollution Control Act			
	• RI Water Quality Regulations for Water Pollution Control (RIGL 46-12 et seq.)	Applicable	Establishes general requirements and effluent limits for discharge to area waters.	In compliance with these regulations, RIPDES requirements pertaining to storm water discharges will be met.
	• RI Regulations for the Pollutant Discharge Elimination System (RIPDES) (RIGL 46-12 et seq.)	Applicable	Permits contain applicable effluent standards (i.e., technology-based and/or water quality-based), monitoring requirements, and standards and special conditions for discharge, including storm water discharges from land disposal facilities which have received industrial wastes.	Storm water discharge improvements would be designed to provide compliance with these regulations and drainage would be monitored in compliance with these regulations.

TABLE 3-10
ALTERNATIVE 3 COST ESTIMATE
RCRA SUBTITLE D SOIL CAP WITH SURFACE AND INSTITUTIONAL CONTROLS
FOCUSED FEASIBILITY STUDY
SITE 01 - McALLISTER POINT LANDFILL
NETC - NEWPORT, RI

Item	Quantity	Units	Unit Price	Basis Year	Reference	Escalation	1993 Unit Costs	1993 Costs	Years (O&M)	Present Value (O&M) [1]
CAPITAL COST - DIRECT										
Permitting and Regulatory Approvals	1	lump sum	$50,000.00	1993	5	1.000	$50,000.00	$50,000.00		$50,000.00
Landfill Gas and Leachate Generation Analyses	1	lump sum	$100,000.00	1993	5	1.000	$100,000.00	$100,000.00		$100,000.00
Site Preparation										
- Clear Vegetation and Brush	10.5	acres	$5,150.00	1993	1	1.000	$5,150.00	$54,075.00		
- Regrade Site and Cutback Slopes	71,000	cu.yd.	$4.90	1993	1	1.000	$4.90	$347,900.00		
- Health & Safety (17%)								$68,335.75		
- Site Access Road	2,200	l. ft.	$14.00	1988	4	1.130	$15.82	$34,804.00		
Subtotal - Site Preparation										$505,114.75
Soil Cap										
- 12" Sand Drainage Layer	17,000	cu.yd.	$18.22	1993	1	1.000	$18.22	$309,740.00		
- 18" Infiltration (Barrier) Layer	25,500	cu.yd.	$25.00	1993	5	1.000	$25.00	$637,500.00		
- 6" Topsoil Layer	50,820	sq. yd.	$4.04	1993	1	1.000	$4.04	$205,312.80		
- Seed, Fertilizer, Mulch	460	msf	$42.50	1993	1	1.000	$42.50	$19,550.00		
- Vertical Gas Vent Wells	11	each	$8,000.00	1988	4	1.130	$9,040.00	$99,440.00		
- Lateral Gas Vent Pipe	6,000	l. ft.	$6.00	1988	4	1.130	$6.78	$40,680.00		
Subtotal - Soil Cap										$1,312,222.80
Surface Controls										
- Silt Fencing	2,500	l. ft.	$1.20	1993	1	1.000	$1.20	$3,000.00		
- Stone Revetment (shoreline protection)	3,600	sq.yd.	$57.50	1993	1	1.000	$57.50	$207,000.00		
- Health & Safety (17%)								$35,190.00		
- Cut Drainage Ditches	2,500	l. ft.	$1.00	1988	4	1.130	$1.13	$2,825.00		
- Riprap (slope protection)	740	cu.yd.	$28.00	1993	1	1.000	$28.00	$20,720.00		
Subtotal - Surface Controls										$268,735.00

TABLE 3-10 (Continued)
ALTERNATIVE 3 COST ESTIMATE
RCRA SUBTITLE D SOIL CAP WITH SURFACE AND INSTITUTIONAL CONTROLS
FOCUSED FEASIBILITY STUDY
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

Item	Quantity	Units	Unit Price	Basis Year	Reference	Escalation	1993 Unit Costs	1993 Costs	Years (O&M)	Present Value (O&M) [1]
Site Access Restrictions										
– Chain Link, 9 gauge wire, aluminized steel, 6' high, plus 3 strands barbed wire	4600	l. ft.	$15.45	1993	1	1.000	$15.45	$71,070.00		
– Double Swing Gate 6' high, 20' opening	1	each	$890.00	1993	1	1.000	$890.00	$890.00		
– Warning Signs	46	each	$43.00	1993	1	1.000	$43.00	$1,978.00		
Total – Site Access Restrictions										
Total Direct Capital Cost										$2,160,010.55
CAPITAL COST – INDIRECT										
Engineering and Design (10 %)					2					$216,001.06
Legal and Administrative (4%)					2					$86,400.42
TOTAL CAPITAL COSTS										$2,462,412.03
OPERATION AND MAINTENANCE COSTS										
– Site Fence Maintenance	1	each	$500.00	1988	3	1.130	$565.00	$565.00	30	$8,685.18
– Cap Annual Inspection and Repairs	1	each	$5,000.00	1988	4	1.130	$5,650.00	$5,650.00	30	$86,851.80
– Landfill Gas Control	1	lump sum	$20,000.00	1988	4	1.130	$22,600.00	$22,600.00	30	$347,407.20
Ground Water Monitoring										
– Sample Collection and Reporting	1	lump sum	$40,000.00	1993	5	1.000	$40,000.00	$40,000.00	30	$614,880.00
– Sample Analysis	40	each	$1,630.00	1993	6	1.000	$1,630.00	$65,200.00	30	$1,002,254.40
Surface Water Discharge Monitoring										
– Collection and Reporting	1	lump sum	$15,000.00	1993	5	1.000	$15,000.00	$15,000.00	30	$230,580.00
– Sample Analysis	2	each	$1,630.00	1993	6	1.000	$1,630.00	$3,260.00	30	$50,112.72
TOTAL NET PRESENT VALUE OF O & M								$152,275.00		$2,340,771.30
SUBTOTAL COST										$4,803,183.33
CONTINGENCY (20%)										$960,636.67
TOTAL PRESENT VALUE COST FOR ALTERNATIVE 3 – RCRA SUBTITLE D SOIL CAP AND SURFACE AND INSTITUTIONAL CONTROLS										$5,763,819.99

(1) – Calculated based on 5% interest rate.

TABLE 3-11
FEDERAL ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 4 - RCRA SUBTITLE C MULTI-LAYER CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	ACTION TAKEN TO MEET ARAR
Capping				
	RCRA (40 CFR 264) Subtitle C Requirements:	Relevant and Appropriate	Outlines specifications and standards for design, operation, closure and monitoring of performance for hazardous waste storage, treatment and disposal facilities.	Substantive RCRA requirements will be met and adhered to on-site.
	• 40 CFR 264.10-264.18 Subpart B - General Facility Standards	Relevant and Appropriate	General requirements regarding waste analysis, security, training, inspections, and location applicable to a facility which stores, treats or disposes of hazardous wastes (a TSDF facility).	This regulation may be applicable to remedial actions which address a waste which is a listed or characteristic waste under RCRA and which constitute current treatment, storage, or disposal as certified by RCRA.
	• 40 CFR 264.30-264.37 Subpart C - Preparedness and Prevention	Relevant and Appropriate	Requirements applicable to the design and operation, equipment, and communications associated with a TSDF facility, and to arrangements with local response departments.	This regulation may be applicable to remedial actions which address a waste which is a listed or characteristic waste under RCRA and which constitute current treatment, storage, or disposal as certified by RCRA.
	• 40 CFR 264.50-264.56 Subpart D - Contingency Plan and Emergency Procedures	Relevant and Appropriate	Emergency planning procedures applicable to a TSDF facility.	This regulation may be applicable to remedial actions which address a waste which is a listed or characteristic waste under RCRA and which constitute current treatment, storage, or disposal as certified by RCRA.
	• 40 CFR 264.90-254.101 Subpart F - Ground Water Protection	Relevant and Appropriate	Ground water monitoring/corrective action requirements; dictates adherence to MCLs and establishes points of compliance.	Studies to be conducted as part of this operable unit will include a ground water monitoring program. Monitoring standards will be met.
	• 40 CFR 264.110-118 Subpart G - Closure/Post Closure Requirements	Relevant and Appropriate	Establishes requirements for the closure and long-term management of a hazardous disposal facility.	Substantive standards and requirements will be met.

TABLE 3-11 (Continued)
FEDERAL ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 4 - RCRA SUBTITLE C MULTI-LAYER CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	ACTION TAKEN TO MEET ARAR
	Subtitle C Requirements (Con't):			
	• 40 CFR 264.301-264.310; Subpart N - Landfill Requirements	Relevant and Appropriate	Placement of cap over hazardous waste requres a cover designed and constructed to comply with regulations. Installation of final cover to provide long-term minimization of infiltration. Restricts post-closure use of property as necessary to prevent damage to cover.	Cap design will meet regulatory requirements. Cap maintenance will be attended to. Closure and post-closure substantive requirements will be complied with.
	• RCRA Proposed Rule 52 FR 8712 Proposed Amendments for Landfill Closures	To Be Considered	Provides an option for the application of alternate closure and post-closure requirements based on a consideration of site-specific conditions including exposure pathways of concern.	Cap and post-closure monitoring will be designed taking into account exposure pathways of concern.
	• EPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments (EPA 530-SW-89-047)	To Be Considered	EPA Technical Guidance for landfill covers. Presents recommended technical specifications for multilayer landfill cover design.	Cap construction should conform to these standards.
	Migratory Bird Treaty Act (16 U.S.C. 703-712)	Applicable	Prohibits hunting, possessing, killing, or capturing of migratory birds, birds in danger of extinction, and those birds' eggs or nests.	Since construction activities during the breeding season may "take" birds or their nests, actions must be taken to avoid destroying nests during breeding season. Phase II environmental assessment will determine if migratory birds live in or around the landfill area.
	Clean Water Act Section 404 (40 CFR 230.10) Requirements for Discharge of Dredged or Fill Material and Rivers and Harbors Act (Section 10) Prohibition of Wetland Filling	Applicable	Prohibits the discharge of dredged or fill material to waters of the United States unless no other practical alternatives are available which pose less of an adverse impact on the aquatic ecosystem or if it causes significant degradation of the water.	The cap and associated shoreline protection along Narragansett Bay will be constructed to meet requirements or mitigation of impacted wetlands will be provided.

TABLE 3-11 (Continued)
FEDERAL ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 4 - RCRA SUBTITLE C MULTI-LAYER CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	ACTION TAKEN TO MEET ARAR
Venting	Clean Air Act (40 CFR 50) New Source Performance Standards (NSPS) Proposed Subpart WWW 56 FR 24468-24528 (5/30/91)	To Be Considered	Requires Best Demonstrated Technology (BDT) for new sources, and sets emissions limitations. Proposed Subpart WWW sets a performance standard for non-methane organic compounds (NMOC) emissions of 150 Mg/yr (167 tpy) for existing municipal solid waste landfills.	These standards should be considered in the design of a landfill gas management system.
	Clean Air Act (40 CFR 61) National Emissions Standards for Hazardous Pollutants (NESHAPS)	To Be Considered	Establishes emissions limitations for hazardous air pollutants and sets forth regulated sources of those pollutants.	Although EPA has not promulgated final Maximum Achievable Control Technology (MACT) standards for municipal landfills, the lead agency should use air control technology to control emissions of hazardous air pollutions. MACT standards prescribe technology that is used by the best 12% of industries in the source category.
	Clean Air Act, Section 5 171 through 178, 42 USC §§ 7471-7478 (Requirements for Non-Attainment Areas)	Applicable or Relevant and Appropriate (Depending on Modelling Results)	RI has adopted State Implementation Plan (SIP) requirements approved and enforcable by EPA which meet the NSR requirement of the CAA. These provisions require that new or modified major sources of VOCs (defined as a source which has the potential to emit 25 tons per year) install equipment to meet Lowest Available Emissions Rate (LAER), which is set on a case-by-case basis and is either the most stringent emissions limitation contained in any SIP for that category or source or the most stringent emissions limitation which is achieved for the source. NSR requirements apply to non-attainment pollutants, which are VOCs and NO_x in RI.	Monitoring will be conducted to determine if the requirements of this standard are applicable or relevant and appropriate based on the emissions levels and on the need to be protective of human health and the environment.

TABLE 3-11 (Continued)
FEDERAL ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 4 - RCRA SUBTITLE C MULTI-LAYER CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	ACTION TAKEN TO MEET ARAR
	Clean Air Act, Section 5 160 through 169A - Prevention of Significant Deterioration Provisions	Applicable or Relevant and Appropriate (Depending on Modelling Results)	RI has adopted SIP requirements approved and enforceable by EPA which meet the New Source Review (NSR) requirements of the CAA. These provisions require that new or modified major sources of VOCs (defined as a source which has the potential to emit 25 tons/year) install equipment to meet Lowest Available Emissions Rate (LAER), which is set on a case-by-case basis and is either the most stringent emissions limitation contained in any SIP for that category or source or the most stringent emissions limitation which is achieved for the source. NSR requirements apply to non-attainment pollutants, which are VOCs and NO_x in RI.	Monitoring will be conducted to determine if the requirements of this standard are applicable or relevant and appropriate based on the emissions levels.
Drainage	Clean Water Act (40 CFR 122-125) National Pollutant Discharge Elimination System (NPDES) Permit Requirements	Applicable	Permits contain applicable effluent standards (i.e., technology-based and/or water quality-based), monitoring requirements, and standards and special conditions for discharges, including storm water discharges from land disposal facilities which have received industrial waste from industrial facilities.	Storm water drainage improvements would be designed to provide compliance with the substantive requirements of these regulations and drainage would be monitored in compliance with these reguations.

TABLE 3-12
STATE ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 4 - RCRA SUBTITLE C MULTI-LAYER CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Capping	RI Hazardous Waste Management Act of 1978 (RIGL 23-19.1 et seq.) Hazardous Waste Management Rules and Regulations and Proposed Amendments:	Relevant and Appropriate	Rules and regulations for hazardous waste generation, transportation, treatment, storage and disposal.	Substantive requirements applicable to closure will be met and adhered to on-site.
	• Section 7	Relevant and Appropriate	Restricts location, design, construction, and operation of landfills from endangering ground water, wetlands or floodplains	Landfill cap will be constructed so as to prevent contamination of ground water, wetlands, or floodplains.
	• Section 8	Relevant and Appropriate	Outlines requirements for ground water protection, general waste analysis, security procedures, inspections and safety.	Remedial actions will comply with substantive portions of this section applicable to landfill closure.
	• Section 9	Relevant and Appropriate	Outlines operational requirements for treatment, storage and disposal facilities.	Remedial actions will comply with substantive portions of this section applicable to landfill closure.
	• Section 10	Relevant and Appropriate	Outlines design and operations requirements for land disposal facilities, including landfills.	Remedial actions will meet all non-location specific requirements of this section applicable to landfill closure.
Venting	RI Clean Air Act (RIGL, Title 23, Chapter 23) General Air Quality and Air Emissions Requirements • RI Air Pollution Control Regulations, RI Dept. fo Health, Div. of Air Pollution Control, effective 8/2/67, amended 5/20/91			
	- Regulation No. 1 - Visible Emissions	Applicable	No air contaminant emissions will be allowed for more than 3 minutes in any one hour which are greater than or equal to 20% opacity.	Air emissions from remedial actions will meet emission levels in regulation.

TABLE 3-12 (Continued)
STATE ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 4 - RCRA SUBTITLE C MULTI-LAYER CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Venting - (Cont.)	- Regulation No. 5 - Fugitive Dust	Applicable	Requires that reasonable precaution be taken to prevent particulate matter from becoming airborne.	On-site remedial actions will use good industrial practices to prevent particulate matter from becoming airborne.
	- Regulation No. 7 - Emissions Detrimental to Person or Property	Applicable	Prohibits emissions of contaminants which may be injurious to human, plant or animal life or cause damage to property or which reasonably interfere with the enjoyment of life and property.	All emissions from landfill vents will meet this requirement or gas treatment will be required.
	- Regulation No. 15 - Control of Organic Solvent Emissions	Applicable	Limits the amount of organic solvents emitted to the atmosphere.	If emissions from landfill gas vents exceed limits in this regulation, emissions controls will be designed and implemented to meet these requirements.
	- Regulation No. 17 - Odors	Applicable	Prohibits the release of objectionable odors across property lines.	No remedial action or air emissions will emit objectionable odors beyond the facility boundary, as practicable.
	- Regulation No. 22 - Air Toxics	Applicable if air emissions contain regulated substances	Prohibits the emission of specified contaminants at rates which would result in ground level concentrations greater than acceptable ambient levels or acceptable ambient levels with LAER, as set in the regulation.	If necessary to meet these standards, air emissions control equipment will be designed for landfill gas emissions control.

TABLE 3-12 (Continued)
STATE ACTION-SPECIFIC ARARs AND TBCs
FOCUSED FEASIBILITY STUDY
McALLISTER POINT LANDFILL
NETC - NEWPORT
ALTERNATIVE 4 - RCRA SUBTITLE C MULTI-LAYER CAP
WITH SURFACE AND INSTITUTIONAL CONTROLS

AUTHORITY/ ACTION	REQUIREMENT	STATUS	SYNOPSIS	APPLICABILITY TO SITE CONDITIONS
Drainage	RI Water Pollution Control Act			
	• RI Water Quality Regulations for Water Pollution Control (RIGL 46-12 et seq.)	Applicable	Establishes general requirements and effluent limits for discharge to area waters.	In compliance with these regulations, RIPDES requirements pertaining to storm water discharges will be met.
	• RI Regulations for the Pollutant Discharge Elimination System (RIPDES) (RIGL 46-12 et seq.)	Applicable	Permits contain applicable effluent standards (i.e., technology-based and/or water quality-based), monitoring requirements, and standards and special conditions for discharge, including storm water discharges from land disposal facilities which have received industrial wastes.	Storm water discharge improvements would be designed to provide compliance with these regulations and drainage would be monitored in compliance with these regulations.

TABLE 3-13
ALTERNATIVE 4 COST ESTIMATE
RCRA SUBTITLE C MULTI-LAYER CAP WITH SURFACE AND INSTITUTIONAL CONTROLS
FOCUSED FEASIBILITY STUDY
SITE 01 - McALLISTER POINT LANDFILL
NETC - NEWPORT, RI

Item	Quantity	Units	Unit Price	Basis Year	Reference	Escalation	1993 Unit Costs	1993 Costs	Years (O&M)	Present Value (O&M) (1)
CAPITAL COST - DIRECT										
Permitting and Regulatory Approvals	1	lump sum	$50,000.00	1993	5	1.000	$50,000.00	$50,000.00		$50,000.00
Landfill Gas and Leachate Generation Analyses	1	lump sum	$100,000.00	1993	5	1.000	$100,000.00	$100,000.00		$100,000.00
Site Preparation										
- Clear Vegetation and Brush	10.5	acres	$5,150.00	1993	1	1.000	$5,150.00	$54,075.00		
- Regrade Site and Cutback Slopes	71,000	cu.yd.	$4.90	1993	1	1.000	$4.90	$347,900.00		
- Health & Safety (17%)								$68,335.75		
- Site Access Road	2,200	l. ft.	$14.00	1988	4	1.130	$15.82	$34,804.00		
Subtotal - Site Preparation										$505,114.75
Multi-Layer Cap										
- 12" Sand Bedding Layer	17,000	cu.yd.	$18.22	1993	1	1.000	$18.22	$309,740.00		
- 24" Low Permeability Clay Layer	34,000	cu.yd.	$25.00	1993	5	1.000	$25.00	$850,000.00		
- 36 mil Geomembrane	460,000	sq.ft.	$1.00	1988	4	1.130	$1.13	$519,800.00		
- 12" Sand Drainage Layer	17,000	cu.yd.	$18.22	1993	1	1.000	$18.22	$309,740.00		
- 18" Protective Soil Layer	25,500	cu.yd.	$11.95	1993	1	1.000	$11.95	$304,725.00		
- 6" Topsoil Layer	50,820	sq. yd.	$4.04	1993	1	1.000	$4.04	$205,312.80		
- Seed, Fertilizer, Mulch	460	msf	$42.50	1993	1	1.000	$42.50	$19,550.00		
- Vertical Gas Vent Wells	11	vents	$8,000.00	1988	4	1.130	$9,040.00	$99,440.00		
- Lateral Gas Vent Pipe	6,000	feet	$6.00	1988	4	1.130	$6.78	$40,680.00		
Subtotal - Multi-Layer Cap										$2,658,987.80
Surface Controls										
- Silt Fencing	2,500	l. ft.	$1.20	1993	1	1.000	$1.20	$3,000.00		
- Stone Revetment (shoreline protection)	3,600	sq.yd.	$57.50	1993	1	1.000	$57.50	$207,000.00		

TABLE 3–13 (Continued)
ALTERNATIVE 4 COST ESTIMATE
RCRA SUBTITLE C MULTI–LAYER CAP WITH SURFACE AND INSTITUTIONAL CONTROLS
FOCUSED FEASIBILITY STUDY
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

Item	Quantity	Units	Unit Price	Basis Year	Reference	Escalation	1993 Unit Costs	1993 Costs	Years (O&M)	Present Value (O&M) (1)
Surface Controls (Cont.)										
– Health & Safety (17%)								$35,190.00		
– Cut Drainage Ditches	2,500	l. ft.	$1.00	1988	1	1.130	$1.13	$2,825.00		
– Riprap (slope protection)	740	cu.yd.	$28.00	1993	1	1.000	$28.00	$20,720.00		
Subtotal – Surface Controls										$268,735.00
Site Survey	1	lump sum	$5,000.00	1993	1	1.000	$5,000.00	$5,000.00		$5,000.00
Site Access Restrictions										
– Chain Link, 9 gauge wire, aluminized steel, 6' high, plus 3 strands barbed wire	4,600	l. ft.	$15.45	1993	1	1.000	$15.45	$71,070.00		
– Double Swing Gate 6' high, 20' opening	1	each	$890.00	1993	1	1.000	$890.00	$890.00		
– Warning Signs	46	each	$43.00	1993	1	1.000	$43.00	$1,978.00		
Subtotal – Site Access Restrictions										$73,938.00
Total Direct Capital Cost										$3,587,837.55
CAPITAL COST – INDIRECT										
Engineering and Design (15%)					2					$538,175.63
Legal and Administrative (5%)					2					$179,391.88
TOTAL CAPITAL COSTS										$4,305,405.06
OPERATION AND MAINTENANCE COSTS										
– Site Fence Maintenance	1	each	$500.00	1988	3	1.130	$565.00	$565.00	30	$8,685.18
– Cap Annual Inspection and Repairs	1	each	$5,000.00	1988	4	1.130	$5,650.00	$5,650.00	30	$86,851.80
– Landfill Gas Control	1	lump sum	$20,000.00	1988	4	1.130	$22,600.00	$22,600.00	30	$347,407.20

TABLE 3-13 (Continued)
ALTERNATIVE 4 COST ESTIMATE
RCRA SUBTITLE C MULTI-LAYER CAP WITH SURFACE AND INSTITUTIONAL CONTROLS
FOCUSED FEASIBILITY STUDY
SITE 01 - McALLISTER POINT LANDFILL
NETC - NEWPORT, RI

Item	Quantity	Units	Unit Price	Basis Year	Reference	Escalation	1993 Unit Costs	1993 Costs	Years (O&M)	Present Value (O&M) (1)
OPERATION AND MAINTENANCE COSTS (Cont.)										
Ground Water Monitoring										
- Sample Collection and Reporting	1	lump sum	$40,000.00	1993	5	1.000	$40,000.00	$40,000.00	30	$614,880.00
- Sample Analysis	40	each	$1,630.00	1993	6	1.000	$1,630.00	$65,200.00	30	$1,002,254.40
Surface Water Discharge Monitoring										
- Collection and Reporting	1	lump sum	$15,000.00	1993	5	1.000	$15,000.00	$15,000.00	30	$230,580.00
- Sample Analysis	2	each	$1,630.00	1993	6	1.000	$1,630.00	$3,260.00	30	$50,112.72
TOTAL NET PRESENT VALUE OF O & M								$152,275.00		$2,340,771.30
SUBTOTAL COST										$6,646,176.36
CONTINGENCY (20%)										$1,329,235.27
TOTAL PRESENT VALUE COST FOR ALTERNATIVE 4 - RCRA SUBTITLE D MULTI-LAYER CAP AND SURFACE AND INSTITUTIONAL CONTROLS										$7,975,411.63

(1) - Calculated based on 5% interest rate.

TABLE 3–14
COMPARISON AMONG ALTERNATIVES
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
FOCUSED FEASIBILITY STUDY
SOURCE CONTROL
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

ACTION	DESCRIPTION
Alternativ 1 – No Action	Least protective alternative; No control of potential exposures to site–related contamination is provided; Does not comply with ARARs; Not effective in the short–term or long–term
Alt rnative 2 – Fencing, Surface Controls and Deed Restrictions	Provides a limited degree of protection of human health and the environment by improving existing site conditions to limit potential migration of contamination and by limiting potential exposures through site fencing and deed restrictions; Does not comply with ARARs; Effective in the short–term but does not provide the long–term effectiveness offered by Alternatives 3 and 4
Alternativ 3 – RCRA Subtitle D Soil Cap with Surface and Institutional Controls	Provides protection of human health and the environment by providing a physical barrier to exposures to surficial contamination while also limiting potential exposures through institutional controls; Does not comply with ARARs; Effective in the short–term and long–term; Provides some protection against infiltration of precipitation
Alternative 4 – RCRA Subtitle C Multi–Layer Cap with Surface and Institutional Controls	Provides protection of human health and the environment by providing a physical barrier to exposures to surficial contamination and to potential infiltration of precipitation and associated leaching of contamination to the ground water; Also limits potential exposures through institutional controls; Complies with ARARs; Effective in the short–term and long–term; The multi–layer design provides extra protection against infiltration

TABLE 3–15
COMPARISON AMONG ALTERNATIVES
OVERALL COMPLIANCE WITH ARARs/TBCs
FOCUSED FEASIBILITY STUDY
SOURCE CONTROL
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

ACTION	CHEMICAL–SPECIFIC	LOCATION–SPECIFIC	ACTION–SPECIFIC
Alternative 1 – No Action	Not Applicable	Does not comply with wetlands or floodplain requirements.	Not Applicable
Alternative 2 – Fencing, Surface Controls and Deed Restrictions	Not Applicable	Does not comply with wetlands or floodplain requirements.	Does not comply with federal or state landfill closure ARARs; Drainage improvements would be designed in accordance with storm water discharge requirements
Alternative 3 – RCRA Subtitle D Soil Cap with Surface and Institutional Controls	Not Applicable	Cap construction would comply with floodplain construction and coastal zone regulations.	Cap does not comply with federal hazardous waste landfill closure ARARs.
Alternative 4 – RCRA Subtitle C Multi–Layer Cap with Surface and Institutional Controls	Not Applicable	Cap construction would comply with floodplain construction and coastal zone regulations.	Cap would comply with state and federal hazardous waste and municipal solid waste landfiill closure ARARs.

TABLE 3-16
COMPARISON AMONG ALTERNATIVES
LONG-TERM EFFECTIVENESS AND PERMANENCE
FOCUSED FEASIBILITY STUDY
SOURCE CONTROL
SITE 01 - McALLISTER POINT LANDFILL
NETC - NEWPORT, RI

ACTION	DESCRIPTION
Alternativ 1 - No Action	Existing site-related risks remain; No controls implemented to limit potential exposures to site contamination; Requires a five-year review
Alt rnative 2 - Fencing, Surface Controls and Deed Restrictions	Relies on institutional controls and minor site improvements to limit exposures to site contamination; Access to contamination along shoreline may be difficult to restrict; Requires a five-year review
Alt rnative 3 - RCRA Subtitle D Soil Cap with Surface and Institutional Controls	Containment of contamination is provided through the physical barrier of a soil cap but residual risk remains due to the continued presence of the landfilled wastes; Effective in the long-term in limiting potential physical exposures to surficial contamination but is not as effective as Altemative 4 in limiting potential infiltration of precipitation or leachate seeps through the side slope of the landfill; Requires a five-year review
Alternative 4 - RCRA Subtitle C Multi-Layer Cap with Surface and Institutional Controls	Containment of contamination is provided through the physical barrier of a multi-layer cap but residual risk remains due to the continued presence of the landfilled wastes; Effective and reliable in the long-term in limiting potential physical exposures to surficial contamination as well as minimizing infiltration of precipitation or leachate seeps through the surface or side slope of the landfill; The multi-layer design enhances the reliability of the cap in preventing infiltration; Requires a five-year review

TABLE 3-17
COMPARISON AMONG ALTERNATIVES
REDUCTION IN TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT
FOCUSED FEASIBILITY STUDY
SOURCE CONTROL
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

ACTION	DESCRIPTION
Alt rnative 1 – No Action	No reductions in toxicity, mobility or volume achieved
Alternative 2 – Fencing, Surface Controls and Deed Restrictions	While no treatment is provided, a slight reduction in the potential mobility of site-related contamination may be achieved through limited site improvements
Alternative 3 – RCRA Subtitle D Soil Cap with Surface and Institutional Controls	While no treatment or destruction of contamination is provided, a reduction in the potential mobility of site-related contamination via control of surface erosion and a reduction in the infiltration of precipitation will be achieved through implementation of a soil cap
Alt rnative 4 – RCRA Subtitle C Multi-Layer Cap with Surface and Institutional Controls	While no treatment or destruction of contamination is provided, a reduction in the potential mobility of site-related contamination via control of surface erosion, infiltration of precipitation and leachate seepage will be achieved through implementation of a multi-layer cap

TABLE 3–18
COMPARISON AMONG ALTERNATIVES
SHORT–TERM EFFECTIVENESS
FOCUSED FEASIBILITY STUDY
SOURCE CONTROL
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

ACTION	DESCRIPTION
Alternative 1 – No Action	No remedial activities conducted; Therefore, no short–term risks result; Remedial response objectives not achieved
Alternative 2 – Fencing, Surface Controls and Deed Restrictions	Minimal short–term risks associated with fence construction and limited surface improvements; Short implementation time frame; Remedial response objectives not achieved
Alternative 3 – RCRA Subtitle D Soil Cap with Surface and Institutional Controls	Potential risks associated with cap construction and fence installation can be minimized through personnel protective equipment; Short–term increases in local traffic could occur as a result of during transporting cap materials to the site; Remedial response objectives are achieved
Alternative 4 – RCRA Subtitle C Multi–Layer Cap with Surface and Institutional Controls	Short–term effectiveness is comparable to Alternative 3; Potential risks associated with cap construction and fence installation can be minimized through personnel protective equipment; Short–term increases in local traffic could occur as a result of transporting cap materials to the site; Requires the longest time to implement due to the comlexity of the cap design; Remedial response objectives are achieved

TABLE 3–19
COMPARISON AMONG ALTERNATIVES
IMPLEMENTABILITY
FOCUSED FEASIBILITY STUDY
SOURCE CONTROL
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

ACTION	DESCRIPTION
Alt rnativ 1 – No Action	Requires no implementation other than a five–year review; Would not limit the implementation of other remedial actions
Alternativ 2 – Fencing, Surface Controls and Deed Restrictions	Easily implemented; Would not limit the implementation of other remedial actions
Alt rnative 3 – RCRA Subtitle D Soil Cap with Surface and Institutional Controls	Relatively easy to implement, requiring commonly used equipment and construction materials and techniques; Location of sufficient volumes of low permeability material for barrier layer may be difficult; Requires extensive site preparation prior to construction; Existing slope along Narragansett Bay may cause difficulties in cap construction in this area of the site; Not a significant barrier to the implementation of other remedial actions.
Alternativ 4 – RCRA Subtitle C Multi–Layer Cap with Surface and Institutional Contr ls	More difficult to implement than Alternative 3, requiring special equipment and materials for geomembrane installation and extra care in placement of overlying cap materials to prevent puncture of the geomembrane; Location of sufficient volumes of low permeability material for barrier layer may be difficult; Requires extensive site preparation prior to construction; Existing slope along Narragansett Bay may cause difficulties in cap construction in this area of the site; Additional site investigations to be conducted to support design activities and to allow for the consideration of other remedial actions in the cap design process, with complementary design features integrated into the final design, as applicable, thereby enhancing the implementation of the final remedy for the site without compromising the integrity of the cap

TABLE 3-20
COMPARISON AMONG ALTERNATIVES
COST
FOCUSED FEASIBILITY STUDY
SOURCE CONTROL
SITE 01 – McALLISTER POINT LANDFILL
NETC – NEWPORT, RI

ACTION	TOTAL CAPITAL COST	ANNUAL O&M COST	PRESENT WORTH O&M COST (1)	TOTAL PRESENT WORTH (2)
Alternative 1 – No Action	--	--	--	Nominal (3)
Alternative 2 – Fencing, Surface Controls and Deed Restrictions	$190,000	$19,000	$290,000	$580,000
Alt rnative 3 – RCRA Subtitle D Soil Cap with Surface and Institutional Controls	$2,500,000	$150,000	$2,300,000	$5,800,000 (4)
Alternative 4 – RCRA Subtitle C Multi-Layer Cap with Surface and Institutional Controls	$4,300,000	$150,000	$2,300,000	$8,000,000 (4)

(1) – Based on 5% discount rate
(2) – Includes 20% contingency on all components
(3) – The only cost associated with the implementation of Alternative 1 would be that associated with conducting a five-year review of the no action decision.
(4) – Additional costs could be incurred if landfill gas treatment is required.

- whether hot spots within the landfill materials, if present, will need to be addressed by a separate remedial action or can be addressed by the landfill cap; and

- the nature and extent of any near-shore sediments which have been affected by site-related contamination, and whether they will need to be addressed by a separate remedial action or whether they can be addressed through consolidation under the landfill cap.

These studies will either be conducted as part of the remedial design process or within the Phase II RI and associated off-shore investigations. The inclusion of an analysis of landfill gas treatment requirements will also be conducted during the remedial design process.

As determined to be necessary based upon the results of these studies, the management of migration operable unit, which will be the second operable unit for the McAllister Point Landfill site, will be developed. The management of migration operable unit will include the following, as necessary:

- the treatment standards and remedial alternative(s) for vented landfill gases;

- the cleanup standards and remedial alternative(s) for hot spots within the landfill materials, if present;

- the cleanup standards and remedial alternatives(s) for contaminated ground water; and

- the cleanup standards and remedial alternative(s) for contaminated sediments.

This alternative will provide the greatest overall protection of human health and the environment of the remedial alternatives evaluated. It will eliminate exposures of human and environmental receptors to the landfill area through engineering controls. It will also comply with ARARs, including hazardous and municipal waste landfill closure requirements and other action-specific and location-specific requirements. Potential risks associated with exposures to contaminated surficial materials will be addressed through the control of potential exposure pathways (through the placement of an impermeable barrier over the areas of contamination and fencing around the site) and through the control of future site usage (through deed restrictions). Implementation of the remedy is not expected to pose unacceptable short-term risks. It meets U.S. EPA expectations regarding Superfund remedial actions, including the use of engineering controls such as containment for waste that poses a relatively low long-term threat or where treatment is impracticable.

This alternative can be fairly easily modified to incorporate other remedial actions, as necessary. If, on the basis of additional investigations, removal and/or treatment of hot spot areas or consolidation of contaminated sediments within the area to be capped is required, these actions could be incorporated into the cap design activities such that they could be conducted prior to the construction of the cap. Similarly, leachate and landfill gas generation can be further evaluated during the landfill cap design with removal and/or treatment systems incorporated as necessary prior to the final design of the cap. A multi-layer cap could also complement a future ground water/leachate remediation action by significantly reducing infiltration as a source of leachate generation and, thereby, reducing the volume of leachate and contaminated ground water requiring treatment over time. This flexibility allows source control remedial decision and conceptual design activities to move forward for this operable unit, while other areas or media of the site requiring additional investigation are further evaluated, in accordance with the Phase II RI/FS Work Plan (TRC, 1992) and the associated remedial design studies.

U.S. EPA, 1989b. CERCLA Compliance with Other Laws Manual: Part II. Clean Air Act and Other Environmental Statues and State Requirements, Office of Solid Waste and Emergency Response, EPA/540/G-89/009, OSWER Directive 9234.1-02, August 1989.

U.S. EPA, 1989c. Requirements for Hazardous Waste Landfill Design, Construction and Closure, August, 1989.

U.S. EPA, 1991a. Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites, Office of Emergency and Remedial Response, EPA/540/P-91/001, OSWER Directive 9355.3-11, February 1991.

U.S. EPA, 1991b. Design and Construction of RCRA/CERCLA Final Covers, Office of Research and Development, EPA/625/4-91/025, May 1991.

USGS, 1984. Elemental Concentrations in Soils and Other Surficial Materials of the Conterminous United States. USGS Professional Paper #1270, Washington, DC: U.S. Government Printing Office.

COST REFERENCES

1. Means Site Work & Landscape Cost Data; 1992.
2. Remedial Action Costing Procedures Manual; JRB Associates; October 1987.
3. Waste Age; March 1988.
4. Waste Alternatives; December 1988.
5. TRC Environmental Corporation; May 1993.
6. Weston Analytics, April 1993.

APPENDIX A

PRELIMINARY COVER INFILTRATION ANALYSIS

APPENDIX A

PRELIMINARY COVER INFILTRATION ANALYSIS

Introduction

To evaluate potential infiltration through the cap for the two final cover (cap) designs considered within this Focused Feasibility Study for the McAllister Point Landfill, the covers were simulated using a nationally recognized model, the Hydrologic Evaluation of Landfill Performance (HELP) computer program. The HELP model was developed by the U.S. Army Corps of Engineers Waterways Experiment Station for the U.S. Environmental Protection Agency (EPA). This program is a quasi-two-dimensional hydrologic model of water movement across, into, through and out of landfills. The model accepts climatologic, soil and design data and utilizes a solution technique that accounts for the effects of surface storage, runoff, infiltration, percolation, evapotranspiration, soil moisture storage and lateral drainage. Landfill systems, including various combinations of vegetation, cover soils, waste cells, special drainage layers and relatively impermeable barrier soils, as well as synthetic membrane covers and liners, may be modelled. The program was developed to facilitate rapid estimation of the amounts of runoff, drainage and leachate that may be expected to result from landfill operation under a wide variety of landfill designs. The model is applicable to open, partially closed and fully closed sites.

For the purposes of conducting this Focused Feasibility Study, the HELP model was utilized to provide a preliminary evaluation of the relative efficiency of the two soil cover designs in limiting infiltration of precipitation and in promoting drainage of precipitation from the cap. This evaluation was not intended to be used in the evaluation of leachate generation. Leachate generation will be addressed under a separate operable unit and additional evaluations of potential leachate generation will be conducted under those studies.

The two final cover designs evaluated using the HELP model include the RCRA Subtitle D soil cover described and evaluated in Section 3.4 and the RCRA Subtitle C multi-layer cap described and evaluated in Section 3.5.

Final Cover Infiltration Modeling

Numerical modeling is the process in which a physical system is first described by analytical mathematical equation(s) and then simulated using a digital computer program to predict its physical processes. This modeling process is necessarily based on many simplifying assumptions. The major assumptions for the HELP program are summarized below.

The HELP model computes the rainfall-runoff on a long-term based statistical average, and therefore cannot provide accurate estimates of runoff volume for individual storm events. It assumes Darcy flow through the soil and does not consider any channeling flow due to soil characteristics such as cracks or root holes. The lateral drainage rate and average saturated depth have been assumed to support the unsaturated drainage as a steady state drainage.

The HELP program requires three general types of input data: climatological data, soil data and design data. Each model run used the same climatological data. The default climatological data of Providence, Rhode Island was selected from the HELP model data bank as input. This data includes five years of historical precipitation data (1974 through 1978). A maximum leaf area index and evaporative zone depth corresponding to vegetative cover of fair grass were assumed.

The soil data were entered separately for each cover design being evaluated. The required data for each cap include the number of layers in the cap, layer types (i.e., vertical percolation, lateral drainage or barrier soil liner), layer thickness, soil texture, soil compaction, initial soil water content, leakage fractions for synthetic membrane liners, vegetative cover type, and runoff curve number.

Design data are also required in the HELP program and include such information as the total landfill surface area (460,000 square feet or 10.5 acres), slope of a lateral drainage layer (4%), and maximum lateral drainage distance along a slope (500 feet).

The HELP program can provide the infiltration results as daily, monthly or annual totals. The soil data input into each model run as well as the total annual infiltration predicted by the model for each of the final cover designs is summarized below.

RCRA Subtitle D Soil Cap - This cap was modeled assuming two layers: a 6-inch vertical percolation vegetative layer and an 18-inch barrier soil layer. The 6-inch layer was assumed to have the default characteristics of a non-compacted loam material while the 18-inch layer was modeled under two cases, each assuming a different compacted soil type. In Case I, the barrier layer was assumed to have the default characteristics of a clay with a saturated hydraulic conductivity of 1.7 x 10^{-5} cm/sec (the hydraulic conductivity value for default soils which is closest to the numeric RCRA Subtitle D hydraulic conductivity requirement for the barrier layer of 1 x 10^{-5} cm/sec). In Case 2, the barrier layer was assumed to have the default characteristics of a liner soil with a saturated hydraulic conductivity of 1.0 x 10^{-7} cm/sec. This default soil has the closest hydraulic conductivity value to the actual measured conductivity of 2.69 x 10^{-7} for the on-site subsoil. The total annual infiltration for each of these assumptions/cases is summarized below:

RCRA Subtitle D	Inches	Cu. Ft.	% of Precipitation
Case 1	7.75	297,116	16.59
Case 2	1.14	43,702	2.44

RCRA Subtitle C Soil Cap - This cap was modeled assuming five layers: a 6-inch vertical percolation vegetative layer; a 12-inch vertical percolation protection layer; a 6-inch vertical percolation filter layer; a 12-inch lateral drainage layer and a layer consisting of a flexible membrane liner and a 24-inch barrier soil layer. The surficial 6-inch layer was assumed to have the default characteristics of a loam material while the underlying 12-inch layer was modeled assuming a fine sand and silt. The following 6-inch vertical percolation (soil filter) and 12-inch lateral drainage layers were assumed to consist of a coarse sand while the barrier soil layer was characterized as a relatively impermeable liner soil. The geomembrane liner was assumed to have a permeability of 1 x 10^{-7} cm/sec. The total annual infiltration for this design is summarized below:

	Inches	Cu. Ft.	% of Precipitation
RCRA Subtitle C	0.002	90	0.01

Detailed HELP modeling input and output results are attached.

Conclusions

Based on this analysis, the reduction in infiltration achievable as a result of implementing a multi-layer cap as opposed to a soil cap is demonstrated. The hydraulic conductivity of the soil barrier implemented within the soil cap greatly impacts its efficiency in restricting infiltration.

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 NETC/McALLISTER POINT LANDFILL, RI
 TRC ENVIRONMENTAL CORPORATION, JO/ZZ, 5/25/93
 MODEL: RCRA SUBTITLE D (case1, w/ soil text = 15)

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                              FAIR GRASS

                               LAYER  1
                               --------

                      VERTICAL PERCOLATION LAYER
   THICKNESS                              =      6.00 INCHES
   POROSITY                               =      0.4630 VOL/VOL
   FIELD CAPACITY                         =      0.2320 VOL/VOL
   WILTING POINT                          =      0.1157 VOL/VOL
   INITIAL SOIL WATER CONTENT             =      0.2320 VOL/VOL
   SATURATED HYDRAULIC CONDUCTIVITY       =      0.001109999954 CM/SEC


                               LAYER  2
                               --------

                          BARRIER SOIL LINER
   THICKNESS                              =     18.00 INCHES
   POROSITY                               =      0.4224 VOL/VOL
   FIELD CAPACITY                         =      0.3495 VOL/VOL
   WILTING POINT                          =      0.2648 VOL/VOL
   INITIAL SOIL WATER CONTENT             =      0.4224 VOL/VOL
   SATURATED HYDRAULIC CONDUCTIVITY       =      0.000000850000 CM/SEC



                        GENERAL SIMULATION DATA
                        -----------------------

   SCS RUNOFF CURVE NUMBER                =      50.00
   TOTAL AREA OF COVER                    =  460000. SQ FT
   EVAPORATIVE ZONE DEPTH                 =      20.00 INCHES
   UPPER LIMIT VEG. STORAGE               =       2.7780 INCHES
   INITIAL VEG. STORAGE                   =       2.3525 INCHES
   INITIAL SNOW WATER CONTENT             =       0.0000 INCHES
   INITIAL TOTAL WATER STORAGE IN
     SOIL AND WASTE LAYERS                =       8.9952 INCHES

             SOIL WATER CONTENT INITIALIZED BY PROGRAM.


                          CLIMATOLOGICAL DATA
                          -------------------

   DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
   SOLAR RADIATION FOR      PROVIDENCE          RHODE ISLAND


   MAXIMUM LEAF AREA INDEX                   = 2.00
   START OF GROWING SEASON (JULIAN DATE)  =  131
   END OF GROWING SEASON (JULIAN DATE)    =  286


          NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

  JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
```

28.20	29.30	37.40	47.90	57.60	66.80
72.50	71.10	63.50	53.20	43.40	32.20

****

MONTHLY TOTALS FOR YEAR 74

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	4.45	3.04	4.51	2.86	2.74	3.28
	1.64	3.10	6.15	2.79	1.56	4.54
RUNOFF (INCHES)	2.305	0.910	1.579	0.226	0.000	0.000
	0.000	0.011	1.875	0.046	0.000	1.325
EVAPOTRANSPIRATION	0.833	1.295	2.386	2.913	2.397	3.287
(INCHES)	1.482	1.210	3.780	2.414	1.745	0.940
PERCOLATION FROM	1.1686	1.0356	1.0723	0.8224	0.1826	0.2563
LAYER 2 (INCHES)	0.0490	0.0402	0.6900	0.8609	0.4477	1.0779

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	5.46	5.01	3.49	2.33	0.08	0.43
LAYER 2 (INCHES)	0.02	0.18	2.52	2.47	0.37	4.55
STD. DEV. OF DAILY HEAD	0.51	0.84	1.42	1.96	0.18	0.79
ON LAYER 2 (INCHES)	0.08	0.99	2.33	1.77	0.55	1.46

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ANNUAL TOTALS FOR YEAR 74

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	40.66	1558633.	100.00
RUNOFF	8.277	317273.	20.36
EVAPOTRANSPIRATION	24.682	946142.	60.70
PERCOLATION FROM LAYER 2	7.7035	295299.	18.95
CHANGE IN WATER STORAGE	-0.002	-81.	-0.01
SOIL WATER AT START OF YEAR	9.98	382401.	
SOIL WATER AT END OF YEAR	9.97	382320.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 75

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	6.78	3.29	3.07	2.99	2.06	4.73

	3.51	2.19	6.15	4.66	6.29	5.11
RUNOFF (INCHES)	1.269	3.245	2.235	0.488	0.000	0.205
	0.000	0.000	1.942	1.013	3.530	1.493
EVAPOTRANSPIRATION	0.583	0.676	1.988	3.144	1.720	4.230
(INCHES)	3.384	1.605	2.709	2.433	1.616	0.619
PERCOLATION FROM	1.1535	1.0413	1.1605	0.6172	0.0946	0.5785
LAYER 2 (INCHES)	0.2985	0.1090	0.4434	1.0786	1.0806	1.0950

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	5.12	5.13	5.27	1.57	0.07	1.71
LAYER 2 (INCHES)	0.58	0.06	1.55	3.65	4.42	3.97
STD. DEV. OF DAILY HEAD	0.51	0.80	0.75	1.87	0.19	1.82
ON LAYER 2 (INCHES)	0.99	0.18	2.38	1.57	1.45	1.47

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ANNUAL TOTALS FOR YEAR 75

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	50.83	1948484.	100.00
RUNOFF	15.420	591089.	30.34
EVAPOTRANSPIRATION	24.705	947038.	48.60
PERCOLATION FROM LAYER 2	8.7508	335448.	17.22
CHANGE IN WATER STORAGE	1.954	74908.	3.84
SOIL WATER AT START OF YEAR	9.97	382320.	
SOIL WATER AT END OF YEAR	10.34	396467.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	1.59	60762.	
ANNUAL WATER BUDGET BALANCE	0.00	1.	0.00

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MONTHLY TOTALS FOR YEAR 76

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	6.38	2.91	3.44	2.00	2.53	1.60
	8.08	7.01	1.57	6.52	0.81	3.46
RUNOFF (INCHES)	6.062	1.287	0.244	0.000	0.000	0.000
	2.537	3.019	0.000	2.188	0.000	0.075
EVAPOTRANSPIRATION	0.781	1.537	2.322	2.309	2.528	1.248
(INCHES)	4.051	5.043	1.486	1.854	1.554	0.636
PERCOLATION FROM	1.1848	1.0309	1.0399	0.3447	0.2209	0.0072
LAYER 2 (INCHES)	0.0877	0.6709	0.0000	0.8067	0.6802	0.5843

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	5.78	4.08	2.84	0.84	0.28	0.00
LAYER 2 (INCHES)	0.19	1.81	0.00	3.37	1.87	2.10
STD. DEV. OF DAILY HEAD	0.36	1.01	1.36	1.39	0.63	0.00
ON LAYER 2 (INCHES)	0.94	1.91	0.00	2.35	1.71	2.34

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ANNUAL TOTALS FOR YEAR 76

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	46.31	1775217.	100.00
RUNOFF	15.413	590829.	33.28
EVAPOTRANSPIRATION	25.349	971717.	54.74
PERCOLATION FROM LAYER 2	6.6581	255229.	14.38
CHANGE IN WATER STORAGE	-1.110	-42558.	-2.40
SOIL WATER AT START OF YEAR	10.34	396467.	
SOIL WATER AT END OF YEAR	10.02	384203.	
SNOW WATER AT START OF YEAR	1.59	60762.	
SNOW WATER AT END OF YEAR	0.79	30468.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 77

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	3.91	2.84	5.63	3.37	3.43	3.92
	2.04	2.12	5.60	6.90	3.09	5.96
RUNOFF (INCHES)	2.662	0.533	3.126	1.266	0.000	0.006
	0.000	0.000	1.060	4.054	0.306	3.895
EVAPOTRANSPIRATION	0.780	1.060	1.934	2.858	3.134	3.299
(INCHES)	2.175	2.124	2.306	2.279	1.281	0.792
PERCOLATION FROM	1.1380	1.0136	1.1488	0.6194	0.4279	0.3826
LAYER 2 (INCHES)	0.1154	0.0000	0.6032	1.1435	1.0366	1.1664

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	4.83	4.52	5.03	2.01	0.90	1.03
LAYER 2 (INCHES)	0.20	0.00	1.91	4.93	3.49	5.41
STD. DEV. OF DAILY HEAD	0.90	0.61	0.91	2.15	1.65	1.85
ON LAYER 2 (INCHES)	0.56	0.00	2.36	0.89	1.46	0.54

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ANNUAL TOTALS FOR YEAR 77

	(INCHES)	(CU. FT.)	PERCENT

PRECIPITATION	48.81	1871050.	100.00
RUNOFF	16.910	648207.	34.64
EVAPOTRANSPIRATION	24.021	920824.	49.21
PERCOLATION FROM LAYER 2	8.7954	337158.	18.02
CHANGE IN WATER STORAGE	-0.917	-35140.	-1.88
SOIL WATER AT START OF YEAR	10.02	384203.	
SOIL WATER AT END OF YEAR	9.90	379531.	
SNOW WATER AT START OF YEAR	0.79	30468.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	9.05 2.52	3.20 5.99	3.10 2.40	2.53 3.22	5.27 2.17	1.97 5.58
RUNOFF (INCHES)	6.912 0.000	2.434 1.234	0.000 0.000	0.000 0.000	0.000 0.000	0.000 2.946
EVAPOTRANSPIRATION (INCHES)	0.634 2.543	1.276 4.316	2.088 2.400	3.111 1.741	4.077 1.128	2.047 0.907
PERCOLATION FROM LAYER 2 (INCHES)	1.1491 0.1644	0.9994 0.4363	0.3098 0.0000	0.5732 0.7196	0.6850 0.4448	0.2436 1.1211

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	5.06 0.31	4.14 1.41	0.37 0.00	1.27 0.79	1.34 0.29	0.14 4.54
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.96 0.79	1.33 2.00	0.91 0.00	1.43 0.66	1.50 0.40	0.26 1.19

ANNUAL TOTALS FOR YEAR 78

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	47.00	1801667.	100.00
RUNOFF	13.526	518490.	28.78
EVAPOTRANSPIRATION	26.270	1007015.	55.89
PERCOLATION FROM LAYER 2	6.8464	262446.	14.57
CHANGE IN WATER STORAGE	0.358	13715.	0.76
SOIL WATER AT START OF YEAR	9.90	379531.	
SOIL WATER AT END OF YEAR	10.26	393245.	
SNOW WATER AT START OF YEAR	0.00	0.	

SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	6.11	3.06	3.95	2.75	3.21	3.10
	3.56	4.08	4.37	4.82	2.78	4.93
STD. DEVIATIONS	2.05	0.19	1.11	0.52	1.25	1.31
	2.62	2.27	2.21	1.87	2.13	0.98
RUNOFF						
TOTALS	3.842	1.682	1.437	0.396	0.000	0.042
	0.507	0.853	0.975	1.460	0.767	1.947
STD. DEVIATIONS	2.486	1.127	1.323	0.526	0.000	0.091
	1.135	1.323	0.956	1.702	1.550	1.491
EVAPOTRANSPIRATION						
TOTALS	0.722	1.169	2.143	2.867	2.771	2.822
	2.727	2.860	2.536	2.144	1.465	0.779
STD. DEVIATIONS	0.107	0.323	0.201	0.335	0.886	1.173
	1.009	1.712	0.829	0.325	0.253	0.149
PERCOLATION FROM LAYER 2						
TOTALS	1.1588	1.0242	0.9462	0.5954	0.3222	0.2936
	0.1430	0.2513	0.3473	0.9219	0.7380	1.0089
STD. DEVIATIONS	0.0182	0.0173	0.3594	0.1702	0.2368	0.2091
	0.0966	0.2908	0.3292	0.1814	0.3083	0.2397

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	46.72	(3.815)	1791010.	100.00
RUNOFF	13.909	(3.370)	533178.	29.77
EVAPOTRANSPIRATION	25.006	(0.849)	958547.	53.52
PERCOLATION FROM LAYER 2	7.7509	(1.0131)	297116.	16.59
CHANGE IN WATER STORAGE	0.057	(1.225)	2169.	0.12

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	4.78	183233.3
RUNOFF	2.537	97248.4

PERCOLATION FROM LAYER 2	0.0391	1499.8
HEAD ON LAYER 2	7.3	
SNOW WATER	4.32	165467.5

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4630
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0973

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	2.66	0.4426
2	7.60	0.4224
SNOW WATER	0.00	

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NETC/McALLISTER POINT LANDFILL, RI
TRC ENVIRONMENTAL CORPORATION, JO/ZZ, 5/25/93
MODEL:RCRA SUBTITLE D (case2, w/ soil taxt = 16)

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4630 VOL/VOL
FIELD CAPACITY	=	0.2320 VOL/VOL
WILTING POINT	=	0.1157 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2320 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001109999954 CM/SEC

LAYER 2

BARRIER SOIL LINER

THICKNESS	=	18.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL
WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000100000 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	50.00
TOTAL AREA OF COVER	=	460000. SQ FT
EVAPORATIVE ZONE DEPTH	=	20.00 INCHES
UPPER LIMIT VEG. STORAGE	=	2.7780 INCHES
INITIAL VEG. STORAGE	=	2.5394 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	9.1320 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR PROVIDENCE RHODE ISLAND

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 131
END OF GROWING SEASON (JULIAN DATE) = 286

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

28.20	29.30	37.40	47.90	57.60	66.80
72.50	71.10	63.50	53.20	43.40	32.20

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MONTHLY TOTALS FOR YEAR 74

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	4.45	3.04	4.51	2.86	2.74	3.28
	1.64	3.10	6.15	2.79	1.56	4.54
RUNOFF (INCHES)	3.427	1.720	2.402	0.895	0.000	0.000
	0.000	0.000	2.116	0.255	0.000	2.800
EVAPOTRANSPIRATION (INCHES)	0.836	1.299	2.392	3.021	2.318	3.802
	1.609	1.245	4.074	2.539	1.804	0.938
PERCOLATION FROM LAYER 2 (INCHES)	0.1399	0.1243	0.1323	0.1209	0.0687	0.0821
	0.0076	0.0047	0.1092	0.1244	0.1189	0.1377

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	5.87	5.47	4.54	3.30	0.39	0.78
	0.04	0.18	2.94	3.22	2.96	5.50
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.26	0.62	1.03	1.62	0.51	1.07
	0.15	0.99	2.16	1.59	0.59	0.71

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ANNUAL TOTALS FOR YEAR 74

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	40.66	1558633.	100.00
RUNOFF	13.614	521856.	33.48
EVAPOTRANSPIRATION	25.875	991889.	63.64
PERCOLATION FROM LAYER 2	1.1706	44872.	2.88
CHANGE IN WATER STORAGE	0.000	16.	0.00
SOIL WATER AT START OF YEAR	10.31	395115.	
SOIL WATER AT END OF YEAR	10.31	395131.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 75

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	6.78	3.29	3.07	2.99	2.06	4.73

	3.51	2.19	6.15	4.66	6.29	5.11
RUNOFF (INCHES)	2.122	4.452	3.024	0.885	0.000	0.286
	0.000	0.000	2.209	1.902	4.594	2.521
EVAPOTRANSPIRATION	0.583	0.676	1.987	3.317	1.972	4.680
(INCHES)	3.595	1.736	2.676	2.396	1.600	0.616
PERCOLATION FROM	0.1400	0.1272	0.1386	0.1152	0.0802	0.0858
LAYER 2 (INCHES)	0.0389	0.0129	0.0694	0.1327	0.1315	0.1357

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	5.89	6.04	5.65	2.27	0.60	2.14
LAYER 2 (INCHES)	0.65	0.08	1.68	4.64	5.17	5.17
STD. DEV. OF DAILY HEAD	0.20	0.04	0.52	1.92	0.47	1.93
ON LAYER 2 (INCHES)	1.04	0.21	2.40	1.07	0.77	0.79

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ANNUAL TOTALS FOR YEAR 75

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	50.83	1948484.	100.00
RUNOFF	21.996	843191.	43.27
EVAPOTRANSPIRATION	25.833	990276.	50.82
PERCOLATION FROM LAYER 2	1.2080	46307.	2.38
CHANGE IN WATER STORAGE	1.792	68708.	3.53
SOIL WATER AT START OF YEAR	10.31	395131.	
SOIL WATER AT END OF YEAR	10.51	403015.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	1.59	60824.	
ANNUAL WATER BUDGET BALANCE	0.00	1.	0.00

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MONTHLY TOTALS FOR YEAR 76

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	6.38	2.91	3.44	2.00	2.53	1.60
	8.08	7.01	1.57	6.52	0.81	3.46
RUNOFF (INCHES)	7.109	1.748	1.188	0.140	0.000	0.000
	2.549	3.313	0.000	2.744	0.000	0.800
EVAPOTRANSPIRATION	0.779	1.531	2.315	2.410	2.902	1.444
(INCHES)	4.087	5.371	1.485	1.836	1.810	0.638
PERCOLATION FROM	0.1404	0.1281	0.1319	0.0852	0.1128	0.0210
LAYER 2 (INCHES)	0.0071	0.0845	0.0000	0.0968	0.1216	0.1246

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	5.94	5.33	4.50	1.69	1.24	0.10
LAYER 2 (INCHES)	0.19	2.18	0.00	3.70	3.40	3.32
STD. DEV. OF DAILY HEAD	0.20	0.55	0.89	1.91	1.16	0.22
ON LAYER 2 (INCHES)	0.97	1.95	0.00	2.47	1.53	2.19

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ANNUAL TOTALS FOR YEAR 76

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	46.31	1775217.	100.00
RUNOFF	19.593	751050.	42.31
EVAPOTRANSPIRATION	26.607	1019938.	57.45
PERCOLATION FROM LAYER 2	1.0540	40403.	2.28
CHANGE IN WATER STORAGE	-0.944	-36174.	-2.04
SOIL WATER AT START OF YEAR	10.51	403015.	
SOIL WATER AT END OF YEAR	10.36	397276.	
SNOW WATER AT START OF YEAR	1.59	60824.	
SNOW WATER AT END OF YEAR	0.79	30390.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 77

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	3.91	2.84	5.63	3.37	3.43	3.92
	2.04	2.12	5.60	6.90	3.09	5.96
RUNOFF (INCHES)	3.795	1.479	3.875	1.706	0.133	0.283
	0.000	0.000	1.494	4.861	1.017	5.195
EVAPOTRANSPIRATION	0.783	1.068	1.944	2.962	3.474	3.494
(INCHES)	2.114	2.209	2.306	2.262	1.275	0.791
PERCOLATION FROM	0.1387	0.1251	0.1376	0.1178	0.0936	0.0496
LAYER 2 (INCHES)	0.0154	0.0000	0.0755	0.1366	0.1292	0.1401

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	5.68	5.64	5.46	2.73	1.36	1.14
LAYER 2 (INCHES)	0.21	0.00	2.17	5.29	4.80	5.88
STD. DEV. OF DAILY HEAD	0.25	0.40	0.62	2.14	1.63	1.85
ON LAYER 2 (INCHES)	0.57	0.00	2.43	0.67	1.16	0.23

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ANNUAL TOTALS FOR YEAR 77

	(INCHES)	(CU. FT.)	PERCENT

PRECIPITATION	48.81	1871050.	100.00
RUNOFF	23.837	913770.	48.84
EVAPOTRANSPIRATION	24.682	946161.	50.57
PERCOLATION FROM LAYER 2	1.1592	44437.	2.37
CHANGE IN WATER STORAGE	-0.869	-33318.	-1.78
SOIL WATER AT START OF YEAR	10.36	397276.	
SOIL WATER AT END OF YEAR	10.29	394347.	
SNOW WATER AT START OF YEAR	0.79	30390.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	9.05	3.20	3.10	2.53	5.27	1.97
	2.52	5.99	2.40	3.22	2.17	5.58
RUNOFF (INCHES)	8.218	2.614	0.000	0.102	0.258	0.000
	0.000	1.351	0.000	0.000	0.000	4.354
EVAPOTRANSPIRATION	0.634	1.274	2.414	3.601	4.373	2.550
(INCHES)	2.764	4.565	2.400	1.717	1.644	0.908
PERCOLATION FROM	0.1396	0.1221	0.1185	0.1177	0.1085	0.0760
LAYER 2 (INCHES)	0.0247	0.0608	0.0000	0.0891	0.1140	0.1375

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	5.83	5.03	2.24	2.71	2.18	0.68
LAYER 2 (INCHES)	0.35	1.57	0.00	1.78	2.10	5.46
STD. DEV. OF DAILY HEAD	0.43	0.87	1.14	1.34	1.87	0.57
ON LAYER 2 (INCHES)	0.82	2.07	0.00	1.27	1.03	0.58

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ANNUAL TOTALS FOR YEAR 78

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	47.00	1801667.	100.00
RUNOFF	16.896	647685.	35.95
EVAPOTRANSPIRATION	28.843	1105645.	61.37
PERCOLATION FROM LAYER 2	1.1085	42493.	2.36
CHANGE IN WATER STORAGE	0.152	5844.	0.32
SOIL WATER AT START OF YEAR	10.29	394347.	
SOIL WATER AT END OF YEAR	10.44	400190.	
SNOW WATER AT START OF YEAR	0.00	0.	

SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	6.11	3.06	3.95	2.75	3.21	3.10
	3.56	4.08	4.37	4.82	2.78	4.93
STD. DEVIATIONS	2.05	0.19	1.11	0.52	1.25	1.31
	2.62	2.27	2.21	1.87	2.13	0.98
RUNOFF						
TOTALS	4.934	2.403	2.098	0.746	0.078	0.114
	0.510	0.933	1.164	1.952	1.122	3.134
STD. DEVIATIONS	2.598	1.224	1.528	0.660	0.116	0.156
	1.140	1.454	1.097	1.987	1.990	1.708
EVAPOTRANSPIRATION						
TOTALS	0.723	1.170	2.210	3.062	3.008	3.194
	2.834	3.025	2.588	2.150	1.627	0.778
STD. DEVIATIONS	0.108	0.321	0.227	0.445	0.954	1.239
	1.022	1.828	0.942	0.357	0.218	0.149
PERCOLATION FROM LAYER 2						
TOTALS	0.1397	0.1254	0.1318	0.1114	0.0927	0.0629
	0.0187	0.0326	0.0508	0.1159	0.1230	0.1351
STD. DEVIATIONS	0.0006	0.0024	0.0080	0.0148	0.0186	0.0274
	0.0134	0.0378	0.0488	0.0216	0.0073	0.0061

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	46.72	(3.815)	1791010.	100.00
RUNOFF	19.187	(4.062)	735510.	41.07
EVAPOTRANSPIRATION	26.368	(1.545)	1010782.	56.44
PERCOLATION FROM LAYER 2	1.1401	(0.0598)	43702.	2.44
CHANGE IN WATER STORAGE	0.026	(1.104)	1015.	0.06

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	4.78	183233.3
RUNOFF	2.549	97727.0

PERCOLATION FROM LAYER 2	0.0046	177.8
HEAD ON LAYER 2	7.1	
SNOW WATER	4.32	165558.6

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4630
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1010

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	2.70	0.4500
2	7.74	0.4300
SNOW WATER	0.00	

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NETC/McALLISTER POINT LANDFILL, RI
TRC ENVIRONMENTAL CORPORATION, JO/ZZ, 5/25/93
MODEL: RCRA SUBTITLE C

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                              FAIR GRASS

                               LAYER  1
                               --------

                      VERTICAL PERCOLATION LAYER
  THICKNESS                          =       6.00 INCHES
  POROSITY                           =       0.4630 VOL/VOL
  FIELD CAPACITY                     =       0.2320 VOL/VOL
  WILTING POINT                      =       0.1157 VOL/VOL
  INITIAL SOIL WATER CONTENT         =       0.2320 VOL/VOL
  SATURATED HYDRAULIC CONDUCTIVITY   =       0.001109999954 CM/SEC


                               LAYER  2
                               --------

                      VERTICAL PERCOLATION LAYER
  THICKNESS                          =      12.00 INCHES
  POROSITY                           =       0.4570 VOL/VOL
  FIELD CAPACITY                     =       0.0831 VOL/VOL
  WILTING POINT                      =       0.0326 VOL/VOL
  INITIAL SOIL WATER CONTENT         =       0.0831 VOL/VOL
  SATURATED HYDRAULIC CONDUCTIVITY   =       0.003100000089 CM/SEC


                               LAYER  3
                               --------

                      VERTICAL PERCOLATION LAYER
  THICKNESS                          =       6.00 INCHES
  POROSITY                           =       0.4170 VOL/VOL
  FIELD CAPACITY                     =       0.0454 VOL/VOL
  WILTING POINT                      =       0.0200 VOL/VOL
  INITIAL SOIL WATER CONTENT         =       0.0454 VOL/VOL
  SATURATED HYDRAULIC CONDUCTIVITY   =       0.009999999776 CM/SEC


                               LAYER  4
                               --------

                        LATERAL DRAINAGE LAYER
  THICKNESS                          =      12.00 INCHES
  POROSITY                           =       0.4170 VOL/VOL
  FIELD CAPACITY                     =       0.0454 VOL/VOL
  WILTING POINT                      =       0.0200 VOL/VOL
  INITIAL SOIL WATER CONTENT         =       0.0454 VOL/VOL
  SATURATED HYDRAULIC CONDUCTIVITY   =       0.009999999776 CM/SEC
  SLOPE                              =       4.00 PERCENT
  DRAINAGE LENGTH                    =     500.0 FEET


                               LAYER  5
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BARRIER SOIL LINER WITH FLEXIBLE MEMBRANE LINER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL
WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000100000 CM/SEC
LINER LEAKAGE FRACTION	=	0.00100000

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	50.00
TOTAL AREA OF COVER	=	460000. SQ FT
EVAPORATIVE ZONE DEPTH	=	20.00 INCHES
UPPER LIMIT VEG. STORAGE	=	9.0960 INCHES
INITIAL VEG. STORAGE	=	3.4201 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	13.5264 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR PROVIDENCE RHODE ISLAND

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	131
END OF GROWING SEASON (JULIAN DATE)	=	286

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.20	29.30	37.40	47.90	57.60	66.80
72.50	71.10	63.50	53.20	43.40	32.20

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MONTHLY TOTALS FOR YEAR 74

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	4.45	3.04	4.51	2.86	2.74	3.28
	1.64	3.10	6.15	2.79	1.56	4.54
RUNOFF (INCHES)	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.833	1.295	2.386	2.760	2.690	3.692
(INCHES)	2.575	1.167	3.903	2.423	1.786	0.934
LATERAL DRAINAGE FROM	1.1228	1.1666	1.3472	1.3497	1.3156	1.2056
LAYER 4 (INCHES)	1.0952	0.9234	0.9583	0.9909	0.9110	0.9752
PERCOLATION FROM	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
LAYER 5 (INCHES)	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	16.99	22.30	25.32	27.72	23.52	19.73
LAYER 5 (INCHES)	15.82	12.75	13.98	13.96	13.07	13.80
STD. DEV. OF DAILY HEAD	2.70	1.11	2.38	1.13	1.22	1.17
ON LAYER 5 (INCHES)	1.23	0.83	1.68	0.32	0.65	1.84

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ANNUAL TOTALS FOR YEAR 74

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	40.66	1558633.	100.00
RUNOFF	0.000	0.	0.00
EVAPOTRANSPIRATION	26.445	1013713.	65.04
LATERAL DRAINAGE FROM LAYER 4	13.3615	512192.	32.86
PERCOLATION FROM LAYER 5	0.0022	84.	0.01
CHANGE IN WATER STORAGE	0.852	32645.	2.09
SOIL WATER AT START OF YEAR	19.73	756485.	
SOIL WATER AT END OF YEAR	20.59	789129.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 75

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	6.78	3.29	3.07	2.99	2.06	4.73
	3.51	2.19	6.15	4.66	6.29	5.11
RUNOFF (INCHES)	0.000	0.000	1.254	0.336	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.101
EVAPOTRANSPIRATION	0.582	0.676	1.977	3.077	1.956	4.787
(INCHES)	5.496	1.761	2.583	2.289	1.559	0.610
LATERAL DRAINAGE FROM	1.2003	1.2069	1.4771	1.3879	1.3589	1.2915
LAYER 4 (INCHES)	1.1796	0.9800	0.8339	1.0809	1.2639	1.4309
PERCOLATION FROM	0.0002	0.0002	0.0003	0.0002	0.0002	0.0002
LAYER 5 (INCHES)	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	18.60	24.88	34.29	30.42	25.89	24.59
LAYER 5 (INCHES)	17.91	13.72	11.75	15.72	23.54	30.15
STD. DEV. OF DAILY HEAD	1.68	3.81	1.59	2.48	1.14	1.41
ON LAYER 5 (INCHES)	2.16	0.77	1.10	1.37	4.72	1.81

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ANNUAL TOTALS FOR YEAR 75

	(INCHES)	(CU. FT.)	PERCENT

PRECIPITATION	50.83	1948484.	100.00
RUNOFF	1.691	64832.	3.33
EVAPOTRANSPIRATION	27.353	1048529.	53.81
LATERAL DRAINAGE FROM LAYER 4	14.6919	563188.	28.90
PERCOLATION FROM LAYER 5	0.0024	92.	0.00
CHANGE IN WATER STORAGE	7.091	271841.	13.95
SOIL WATER AT START OF YEAR	20.59	789129.	
SOIL WATER AT END OF YEAR	26.09	1000040.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	1.59	60930.	
ANNUAL WATER BUDGET BALANCE	0.00	1.	0.00

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MONTHLY TOTALS FOR YEAR 76

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	6.38	2.91	3.44	2.00	2.53	1.60
	8.08	7.01	1.57	6.52	0.81	3.46
RUNOFF (INCHES)	5.813	1.268	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION (INCHES)	0.774	1.517	2.298	2.467	2.634	2.537
	4.428	6.393	3.006	1.823	1.710	0.633
LATERAL DRAINAGE FROM LAYER 4 (INCHES)	1.4904	1.3741	1.4482	1.3545	1.3250	1.2096
	1.0625	1.3298	1.1650	1.1499	1.1984	1.1376
PERCOLATION FROM LAYER 5 (INCHES)	0.0003	0.0002	0.0002	0.0002	0.0002	0.0002
	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 5 (INCHES)	35.74	33.34	31.37	28.13	24.08	20.03
	15.18	24.29	18.51	17.24	19.37	16.69
STD. DEV. OF DAILY HEAD ON LAYER 5 (INCHES)	0.40	1.43	1.42	2.12	1.13	1.47
	0.94	3.43	1.89	1.84	0.91	0.72

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ANNUAL TOTALS FOR YEAR 76

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	46.31	1775217.	100.00
RUNOFF	7.081	271419.	15.29
EVAPOTRANSPIRATION	30.222	1158507.	65.26
LATERAL DRAINAGE FROM LAYER 4	15.2450	584393.	32.92
PERCOLATION FROM LAYER 5	0.0025	95.	0.01
CHANGE IN WATER STORAGE	-6.240	-239197.	-13.47

SOIL WATER AT START OF YEAR	26.09	1000040.	
SOIL WATER AT END OF YEAR	20.64	791294.	
SNOW WATER AT START OF YEAR	1.59	60930.	
SNOW WATER AT END OF YEAR	0.80	30479.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 77

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	3.91	2.84	5.63	3.37	3.43	3.92
	2.04	2.12	5.60	6.90	3.09	5.96
RUNOFF (INCHES)	0.000	0.000	0.695	1.182	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	1.538
EVAPOTRANSPIRATION	0.778	1.055	1.928	2.752	3.361	3.484
(INCHES)	4.408	2.349	2.189	2.169	1.247	0.783
LATERAL DRAINAGE FROM	1.2254	1.2066	1.4320	1.3975	1.3923	1.2961
LAYER 4 (INCHES)	1.1552	0.9521	0.7901	1.1923	1.3188	1.4480
PERCOLATION FROM	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
LAYER 5 (INCHES)	0.0002	0.0002	0.0001	0.0002	0.0002	0.0002

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	19.37	24.78	30.80	31.20	27.64	24.83
LAYER 5 (INCHES)	17.45	13.24	10.93	20.25	26.15	32.06
STD. DEV. OF DAILY HEAD	2.10	0.40	3.17	2.70	1.39	1.14
ON LAYER 5 (INCHES)	2.58	0.83	0.53	5.53	0.90	3.19

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ANNUAL TOTALS FOR YEAR 77

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	48.81	1871050.	100.00
RUNOFF	3.415	130917.	7.00
EVAPOTRANSPIRATION	26.502	1015914.	54.30
LATERAL DRAINAGE FROM LAYER 4	14.8064	567577.	30.33
PERCOLATION FROM LAYER 5	0.0024	94.	0.01
CHANGE IN WATER STORAGE	4.084	156548.	8.37
SOIL WATER AT START OF YEAR	20.64	791294.	
SOIL WATER AT END OF YEAR	25.52	978320.	
SNOW WATER AT START OF YEAR	0.80	30479.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

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MONTHLY TOTALS FOR YEAR 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	9.05	3.20	3.10	2.53	5.27	1.97
	2.52	5.99	2.40	3.22	2.17	5.58
RUNOFF (INCHES)	6.506	2.351	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.631	1.259	2.335	2.886	4.481	2.781
(INCHES)	3.348	5.026	2.401	1.644	1.541	0.853
LATERAL DRAINAGE FROM	1.4809	1.3298	1.3873	1.3088	1.3020	1.2165
LAYER 4 (INCHES)	1.1012	1.0159	0.8938	0.7909	0.6610	0.8714
PERCOLATION FROM	0.0003	0.0002	0.0002	0.0002	0.0002	0.0002
LAYER 5 (INCHES)	0.0002	0.0002	0.0002	0.0002	0.0001	0.0002

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON	34.73	33.61	27.36	25.59	22.79	20.30
LAYER 5 (INCHES)	15.94	14.39	12.75	10.46	8.58	12.02
STD. DEV. OF DAILY HEAD	1.27	1.61	1.29	0.85	0.89	1.39
ON LAYER 5 (INCHES)	1.21	0.45	0.81	0.59	0.51	3.28

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ANNUAL TOTALS FOR YEAR 78

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	47.00	1801667.	100.00
RUNOFF	8.856	339485.	18.84
EVAPOTRANSPIRATION	29.187	1118828.	62.10
LATERAL DRAINAGE FROM LAYER 4	13.3594	512111.	28.42
PERCOLATION FROM LAYER 5	0.0023	87.	0.00
CHANGE IN WATER STORAGE	-4.405	-168845.	-9.37
SOIL WATER AT START OF YEAR	25.52	978320.	
SOIL WATER AT END OF YEAR	21.12	809476.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	-1.	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	6.11	3.06	3.95	2.75	3.21	3.10
	3.56	4.08	4.37	4.82	2.78	4.93
STD. DEVIATIONS	2.05	0.19	1.11	0.52	1.25	1.31
	2.62	2.27	2.21	1.87	2.13	0.98
RUNOFF						
TOTALS	2.464	0.724	0.390	0.304	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.328
STD. DEVIATIONS	3.382	1.062	0.569	0.512	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.678
EVAPOTRANSPIRATION						
TOTALS	0.720	1.160	2.185	2.789	3.024	3.456
	4.051	3.339	2.817	2.070	1.568	0.763
STD. DEVIATIONS	0.107	0.317	0.215	0.223	0.954	0.884
	1.121	2.256	0.678	0.326	0.207	0.140
LATERAL DRAINAGE FROM LAYER 4						
TOTALS	1.3040	1.2568	1.4184	1.3596	1.3387	1.2439
	1.1187	1.0403	0.9282	1.0410	1.0706	1.1726
STD. DEVIATIONS	0.1701	0.0898	0.0513	0.0351	0.0366	0.0458
	0.0476	0.1654	0.1467	0.1592	0.2777	0.2615
PERCOLATION FROM LAYER 5						
TOTALS	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	46.72	(3.815)	1791010.	100.00
RUNOFF	4.209	(3.692)	161331.	9.01
EVAPOTRANSPIRATION	27.942	(1.689)	1071098.	59.80
LATERAL DRAINAGE FROM LAYER 4	14.2928	(0.8758)	547892.	30.59
PERCOLATION FROM LAYER 5	0.0024	(0.0001)	90.	0.01
CHANGE IN WATER STORAGE	0.276	(5.605)	10598.	0.59

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	4.78	183233.3
RUNOFF	2.053	78704.0
LATERAL DRAINAGE FROM LAYER 4	0.0482	1847.2
PERCOLATION FROM LAYER 5	0.0000	0.3

HEAD ON LAYER 5	36.3	
SNOW WATER	4.33	165793.9
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4548	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0562	

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	1.47	0.2456
2	2.29	0.1909
3	2.03	0.3382
4	5.00	0.4170
5	10.32	0.4300
SNOW WATER	0.00	

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